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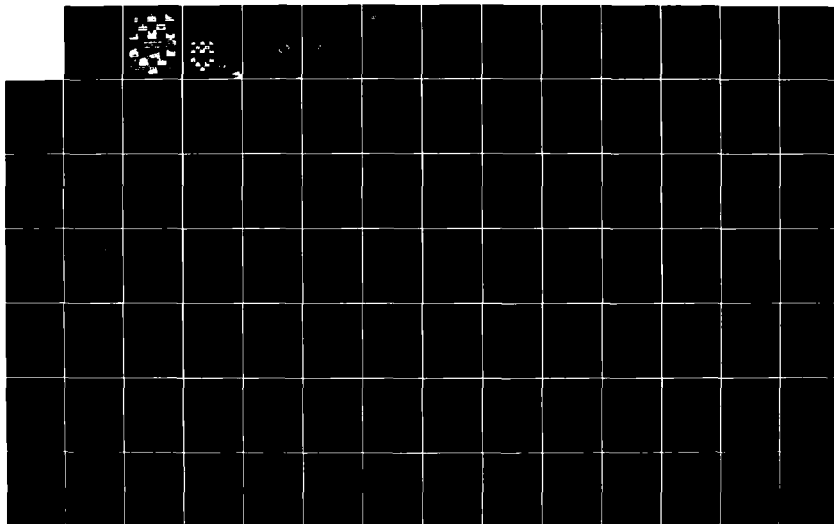
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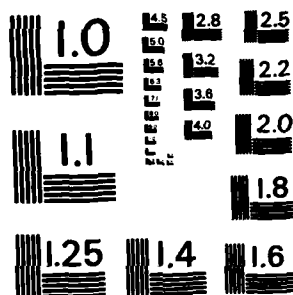
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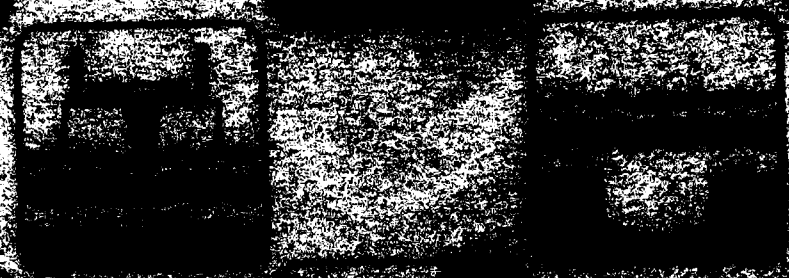
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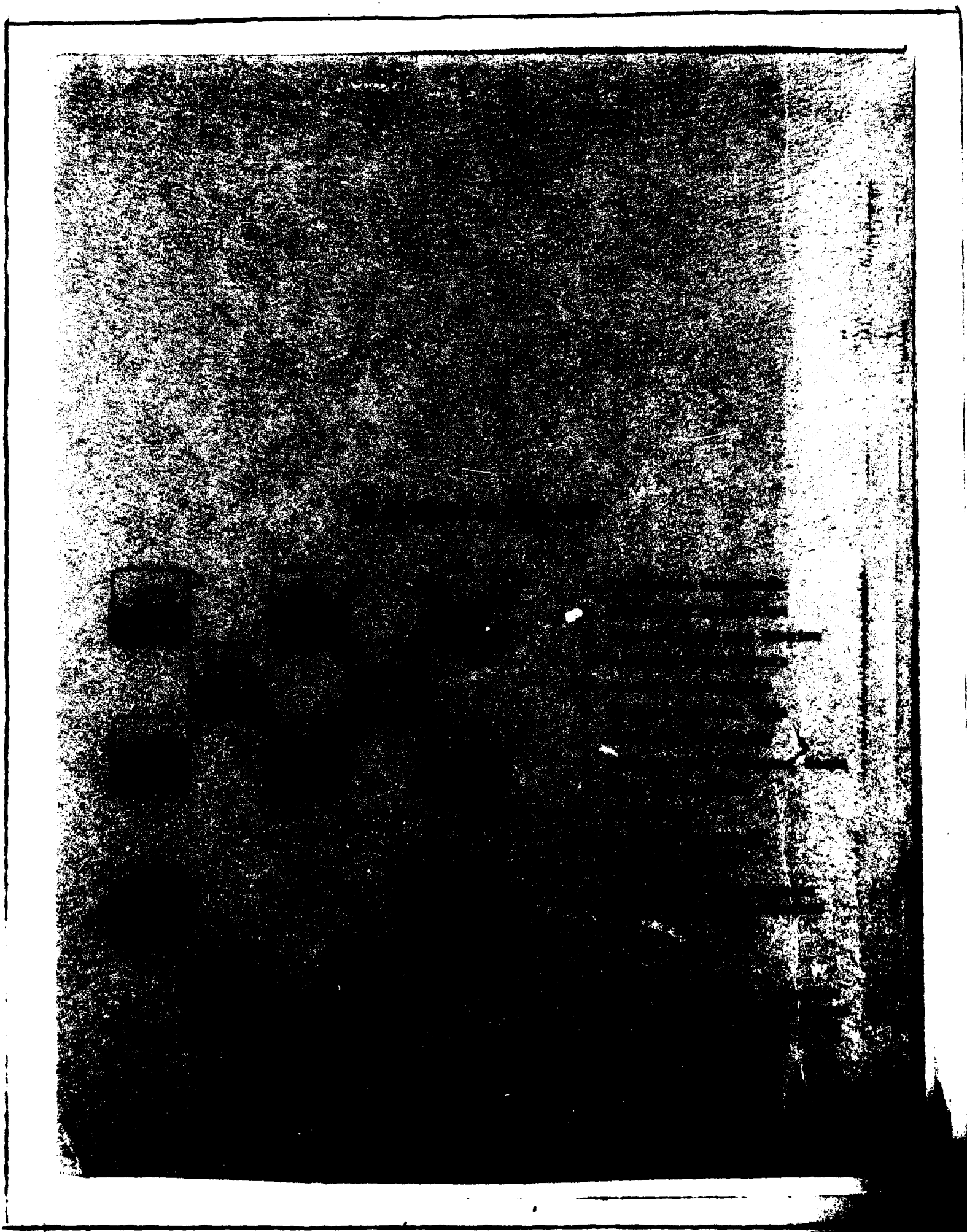




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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) IMPLEMENTATION FOR GREAT I STUDY.		5. TYPE OF REPORT & PERIOD COVERED
7. AUTHOR(s)		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Department of the Army Corps of Engineers, St. Paul District 1135 USPO & Custom House, St. Paul, MN 55101		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Department of the Army Corps of Engineers, North Central Division 536 S. Clark Street Chicago, IL 60605		12. REPORT DATE June, 1981
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited		13. NUMBER OF PAGES
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		15. SECURITY CLASS. (of this report)
18. SUPPLEMENTARY NOTES		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Mississippi River Water Resources Development Dredging Channels (Waterways).		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This reports provides the Corps of Engineers, St. Paul District's perspective on the findings of GREAT I. The data and documents of the GREAT I report should be referred to for further details. The principal aspect of river management discussed is maintenance dredging of the 9-foot channel along the Mississippi River and tributaries upstream of Guttenberg, Iowa, and management problems which result from this dredging.		

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**DEPARTMENT OF THE ARMY**  
NORTH CENTRAL DIVISION, CORPS OF ENGINEERS  
536 SOUTH CLARK STREET  
CHICAGO, ILLINOIS 60605

NCDPD

31 July 1981

**NOTICE OF THE FINAL REPORT  
FOR  
GREAT I AND GREAT II  
(Great River Environmental Action Team)  
UPPER MISSISSIPPI RIVER RESOURCE MANAGEMENT STUDY**

This announcement is to notify the public that the final reports for GREAT I and GREAT II have been completed by the District Engineer, St. Paul, and District Engineer, Rock Island, and the Division Engineer, North Central Division, U. S. Army Corps of Engineers.

**INTRODUCTION**

The GREAT I study, initiated in 1974, covers the St. Paul District portion of the Upper Mississippi River from Minneapolis/St. Paul, Minnesota, to Guttenberg, Iowa. The GREAT II study, initiated in 1976, covers the Rock Island District portion of the river from Guttenberg, Iowa, to Saverton, Missouri. Both studies began because of concerns over the environmental impacts of methods used to operate and maintain the navigation system on the Upper Mississippi River. The GREAT studies were conducted by Federal-State interagency teams under the guidance of the Upper Mississippi River Basin Commission. They considered all aspects of the river including dredging requirements and equipment needs for channel maintenance, use of dredged material, commercial transportation, floodplain management, recreation, water quality, sediment and erosion control, fish and wildlife, and preservation of cultural and aesthetic values. The GREAT Teams developed recommendations in all of these areas; many of the recommendations were directed at the Corps of Engineers for implementation. To supplement the GREAT reports, the St. Paul and Rock Island District Engineers have prepared reports outlining how they intend to implement the GREAT Team recommendations in their respective Districts. Both District Engineers intend to implement, through the established budgeting process, what they consider high priority recommendations at an estimated cost increase of \$3 million annually in the St. Paul District and \$2 million annually in the Rock Island District.

**STUDY AUTHORITY**

The principal authority for these reports is Section 117 of the Water Resources Development Act of 1976 (Public Law 94-587). Section 117 reads:

The Secretary of the Army, acting through the Chief of Engineers, is

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authorized to investigate and study, in cooperation with interested States and Federal agencies, through the Upper Mississippi River Basin Commission the development of a river system management plan in the format of the "Great River Study" for the Mississippi River from the mouth of the Ohio River to the head of navigation at Minneapolis, incorporating total river resource requirements, including, but not limited to, navigation, the effects of increased barge traffic, fish and wildlife, recreation, watershed management, and water quality at an estimated cost of \$9,100,000.

#### BACKGROUND

In the 1960's and early 1970's, conservation organizations, commercial fishermen, biologists, and sportsmen expressed concern over the environmental impacts of methods used to operate and maintain the navigation system of the Upper Mississippi River. Their concerns were directed to the U. S. Army Corps of Engineers, the agency assigned by Congress to maintain the navigation system. In 1974, the St. Paul and Rock Island Districts completed Environmental Impact Statements (EIS) in accordance with the National Environmental Policy Act of 1969. The EIS described the effects of the Corps of Engineers' operation and maintenance program on the Upper Mississippi River. These documents concluded that sediment from uplands and streambanks, as well as placement of dredged material, was damaging the river's biologically productive backwaters, marshes, and sloughs. The EIS also revealed that little information was available on many other aspects of the river. The lack of information made it difficult for government agencies or the Congress to evaluate ways to manage the river while balancing the demands of competing uses.

As a result of growing congressional and public interest in the problems of the Upper Mississippi River, the North Central Division Engineer of the Corps of Engineers and the North Central Regional Director of the U. S. Fish and Wildlife Service announced in September 1974 the establishment of a partnership team to work out long-range management strategies for the multi-purpose use of the river. In October 1974, this team evolved into GREAT--a working partnership of Federal agencies, States, and the public--under the sponsorship of the Upper Mississippi River Basin Commission.

The Team, established in 1974, was called GREAT I and studied the Upper Mississippi River from Minneapolis/St. Paul to Lock and Dam 10 at Guttenberg, Iowa. GREAT II was organized in 1976 and studied the river from Guttenberg to Saverton, Missouri. GREAT III was organized in 1977 and encompasses the Mississippi River from Saverton to the mouth of the Ohio River. The GREAT I Team Report was completed in September 1980, and the GREAT II Team Report was completed in December 1980. The GREAT III report is scheduled to be completed in fiscal year 1984.

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### STUDY TEAM ORGANIZATION

The GREAT Teams were made up of representatives from the following State and Federal agencies:

#### GREAT I

U. S. Department of the Army  
Corps of Engineers  
St. Paul District

U. S. Department of the Interior  
Fish and Wildlife Service  
Region III

U. S. Department of Agriculture  
Soil Conservation Service  
Minnesota Office

U. S. Department of Transportation  
Coast Guard - 2d District

U. S. Environmental Protection Agency  
Region V

State of Iowa  
Iowa Conservation Commission

State of Minnesota  
Department of Natural Resources

State of Wisconsin  
Department of Natural Resources

Upper Mississippi River Conservation  
Committee - Nonvoting Member

Minnesota-Wisconsin Boundary Area  
Commission - Nonvoting Member

#### GREAT II

U. S. Department of the Army  
Corps of Engineers  
Rock Island District

U. S. Department of the Interior  
Fish and Wildlife Service  
Region III

U. S. Department of Agriculture  
Soil Conservation Service  
Iowa Office

U. S. Department of Transportation  
Coast Guard - 2d District

U. S. Environmental Protection Agency  
Region VII

State of Iowa  
Iowa Conservation Commission

State of Illinois  
Department of Transportation and  
Department of Conservation

State of Missouri  
Department of Conservation and  
Department of Natural Resources

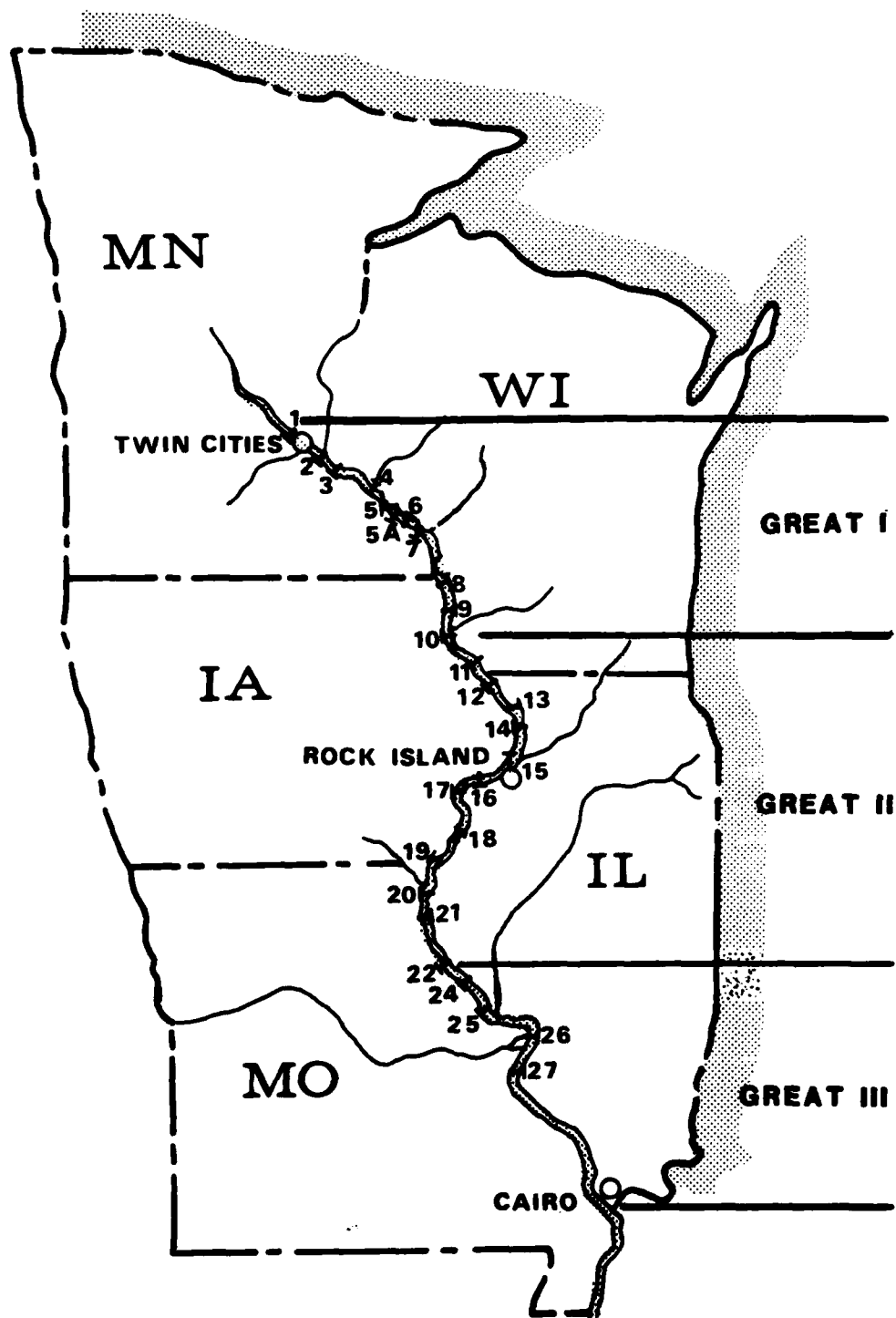
State of Wisconsin  
Department of Natural Resources

Upper Mississippi River Conservation  
Committee - Nonvoting Member

### DESCRIPTION OF STUDY AREA

#### The Navigation Project

The Upper Mississippi River 9-foot channel navigation project, extending from the mouth of the Missouri River to Minneapolis, a distance of 658 miles, was authorized by Congress in 1930. A map of the project is shown on page 4.



**UPPER MISSISSIPPI RIVER**  
**GREAT STUDY REACHES & LOCKS AND DAMS**

The principal engineering features are 29 locks and dams, spaced at irregular intervals to maintain a 9-foot navigation channel. All locks of the system were originally built to provide a width of 110 feet and a length of at least 600 feet, with the exception of the Upper and Lower St. Anthony Falls Locks and Lock No. 1, located near the head of navigation within the city of Minneapolis. These locks at the head of navigation have a width of only 56 feet and a length of 400 feet. Lock No. 19 at Keokuk, Iowa, is 1,200 feet in length and opened in May 1957. Locks No. 27 at the Chain of Rocks Canal near St. Louis was opened in 1953 and consists of one 1,200-foot main lock and one 600-foot auxiliary lock. Construction of a 1,200-foot replacement for Locks and Dam No. 26 at Alton, Illinois, is currently underway. The general location and number of locks and dams necessary for the project were fixed by the river profile. The practicable heights of the dams were limited by flowage damage. So far as possible, the locks and dams were located in fairly straight stretches so as to avoid cross-currents and to afford navigation easy upstream and downstream approaches.

The navigation dams on the Upper Mississippi River were constructed to regulate water level stages of the river at low flow and to pass high river flows without raising river stages above those that would exist without the dams. The dams are provided with gates which can be raised to permit the flow of the river to pass underneath them, as under natural conditions. Thus, at high water, the river surface profile will have practically the same slope as in a natural state; while at low water, the river consists of a series of reservoirs providing a stairway for waterborne traffic.

The dams are spaced at intervals varying from 0.4 to 46.3 miles. The average pool length is 25 miles. The lift of locks varies from 5.5 to 49.2 feet with an average lift of 12.9 feet. The area encompassed by GREAT I and GREAT II extends from the head of navigation to Lock and Dam No. 22.

#### Fish and Wildlife Values

The Upper Mississippi River valley supports one of the most diverse ecological communities in terms of habitat and species abundance and variety on the North American continent. The unique plant and animal life of the valley results from the overlapping of eastern and western species and an intrusion of southern species up the river valley.

Before construction of the locks and dams system, the river bottoms were primarily wooded islands. The islands also contained some hay meadows and small farming areas. Deep sloughs were the rule, but hundreds of lakes and ponds were scattered through the wooded area. Marshes were limited to the lakeshores and ditches leading off the sloughs. These marshes often dried up completely. Fish rescue work was a big activity, with crews rescuing fish trapped in bottomland lakes and ponds when the river receded.

In the early thirties, the Corps of Engineers initiated work on the 9-foot channel commercial navigation project. Resulting impoundments abruptly changed the river bottoms from areas of wide fluctuations in pool levels to areas of semistabilized water in which, while spring floods still occur, the bottoms do not dry out in the summer. Thus, instead of wooded islands and dry marshes, marsh and aquatic habitat with fairly stable water levels are available throughout the year.

In each of the pools, three distinct zones occur. The upper end of each pool is in essentially the normal river condition where the water levels were not raised to any large extent. In this portion of the pools, marsh development is limited and the old conditions of deep sloughs and wooded islands are found. In the middle portion of each pool, impoundment backed up water over islands and old hay meadows, spreading out over large areas of comparatively shallow water. It is in the middle portion of the pools that the best marsh development occurred. Immediately above each dam, the water was impounded to a depth which precluded marsh development; at present, this area is essentially deep, open water in which some aquatic growth occurs, but in which there is practically no marsh.

Two extensive wildlife refuges are located on the Mississippi River. The Upper Mississippi River Wild Life and Fish Refuge, authorized in 1924, extends from Wabasha, Minnesota, mile 760, to Rock Island, Illinois, mile 490. The Mark Twain National Wildlife Refuge, established in 1958, covers the area from Rock Island, Illinois, mile 490, to St. Louis, Missouri, mile 195. About 227,000 acres of refuge lands are distributed along 534 miles of the Mississippi River. The river valley is best known for its value as a migratory corridor for birds, especially waterfowl, of international significance.

#### The Problem of Sedimentation

In a free-flowing river, erosion and sedimentation maintain a longterm equilibrium. Sediment deposits in the marshes and backwaters are balanced by the river's creation of new channels and wetlands. The wing dams and closing dams system that preceded the locks and dams stabilized the alignment of the main channel and enhanced the river's ability to transport sediment. Formation of the navigation pools created thousands of acres of wetlands and backwater, but reduced the river's ability to transport sediment through the natural scouring process. Approximately one-quarter of the open water area present when the lock and dam system was completed has become marshland.

The primary source of fine sediments which settle out and clog the backwaters is erosion from farmlands. However, a reduction in erosion alone would not necessarily solve the problem. Sedimentation and shoaling also depend on the river's energy dynamics and local geography as well as the availability of suspended sediment.

Sand sediments which accumulate and cause shoaling must be dredged to maintain the navigation channel. The primary source of the sand which fills the main channel is streambank erosion from tributaries. The majority of this sand in the GREAT I area appears to come from key sand-producing tributaries; the greatest single contributor of sand is the Chippewa River in Wisconsin. GREAT II studies do not show the same correlation between tributary sand inputs and dredging requirements.

Thus, the problems confronting resource managers are whether the backwater sedimentation can be counteracted, and where and how to dispose of coarse sediments dredged from the navigation channel.



## SCOPE OF THE GREAT STUDIES

The overall goal of the GREAT studies was to develop a river system management plan as specified in the authorizing legislation. To further this goal, the GREAT I and GREAT II study teams conducted investigations in the following areas.

Channel Maintenance - The Teams identified environmentally sound procedures for the Corps of Engineers to follow in conducting dredging operations and placing dredged material. They agreed on methods that would protect environmental values; provide for beneficial use of the dredged material; and build a recognition of water quality, floodplain management, and recreation needs into the process. The GREAT I Channel Maintenance Plan is a detailed, site-specific dredged material placement plan. The GREAT II Team developed a procedure for selection of placement sites as outlined in a Channel Maintenance Handbook.

Commercial Transportation - The study participants addressed such issues as removing existing constraints and providing for future expansion of navigation traffic; evaluating the requirements for navigation safety in regards to channel dimensions, obstructive bridges, and other hazards; providing adequate mooring and fleeting areas; and the demand for and importance of river transportation.

Commercial, Industrial, and Utility Development - Studies were outlined to continue commercial and industrial activities in a manner that would protect the environment.

Floodplain Management - Participants dealt with the problems of inconsistent floodplain laws, regulations, and enforcement programs between the States and agencies involved and identification of the effects of sediment buildup on flood stages.

Recreation - Recreation work groups evaluated recreation needs, proposed additional recreational facilities, and investigated congestion at locks with heavy recreation use. They also considered beach nourishment with dredged material and the issue of private leases of Federal lands.

Water Quality - These efforts focused on developing consistent water quality criteria among States and Federal agencies, promoting enforcement of existing regulations to protect the river water and establishment of monitoring stations below large urban areas and waste pretreatment programs in certain areas. Studies on the water quality effects of navigation and of mechanical and hydraulic dredging were conducted.

Sediment and Erosion - These studies collected and evaluated data to describe the relationship between upland and streambank erosion and the sedimentation of Mississippi River backwaters. They also attempted to determine sedimentation rates in open-water areas. Upland watershed treatment programs (such as reduced-tillage farming) were also addressed.

Fish and Wildlife - The fish and wildlife studies emphasized collection and analysis of information to better document and assess impacts on fish and wildlife of the river from municipal, residential, industrial, navigational, and recreational encroachments. Team members also evaluated methods to improve

habitat in backwater areas by changing the amounts of flow entering the backwater through side-channel openings.

Cultural and Aesthetic - These studies addressed preservation of qualities essential for human enjoyment of the river corridor.

Dredging Requirements, Dredged Material Uses, and Material and Equipment Needs - The factors which affect dredging requirements were analyzed, including depth and width relationships, effectiveness of sediment control on tributaries, and sediment transport modeling. The potential uses and users of dredged material were identified and evaluated. Potentially usable types of dredging equipment were studied, and techniques were investigated for estimating dredging costs using alternative dredging equipment.

#### PRODUCTS OF THE GREAT STUDIES

The partnership nature of the GREAT I and GREAT II study efforts resulted in completion of GREAT I and II "Team Reports", which contain recommendations for the Corps of Engineers, other Federal agencies, States, local governments, and the public. To provide a vehicle for following up on recommendations addressed to the Corps of Engineers, each District Engineer produced an Implementation Report. The Implementation Reports contain information about the costs, legislative authorities needed, and District priority ratings for carrying out these recommendations. The reports are suitable for processing by the organizational review levels of the Corps. Throughout the GREAT studies, the Corps' voting Team members attempted to play a positive role; they did not vote against recommendations where the Corps could, in good faith, take at least some positive action. The Implementation Reports have carried forward this philosophy.

#### The GREAT I Implementation Report

The Implementation Report for GREAT I highlights the St. Paul District's program to address the 112 recommendations of GREAT I. Eighty of these recommendations are directed at the St. Paul District for implementation. The Implementation Report describes three levels of implementation, from a "Basic Program" with no additional funding being available, to a Full GREAT I program which includes actions required by the District to fully implement all appropriate recommendations. A "First Priority Program" is presented; this is the District recommendation for implementation of GREAT recommended actions through FY 1988. The Basic Program includes 27 of the GREAT I Team recommendations; the First Priority Program includes 25 additional recommendations. The Full GREAT I Program would include 28 more recommendations.

If the recommended First Priority Program were implemented, it would require an increased operation and maintenance funding of about \$3 million annually. Implementation of the GREAT I Channel Maintenance Plan is included in the First Priority Program; however, variances to certain State laws and regulations would be necessary for full implementation of the Channel Maintenance Plan.

This funding would, over time, enable the St. Paul District to implement the Channel Maintenance Plan (including detailed evaluations of selected placement sites, coordination of necessary revisions to the plan, acquisition of rights on private land from voluntary sellers for placement of dredged material where it is clearly in the best interest of the river resource, reduction of dredging quantities, and development of long-term plans for placement site use) at an average increase of about \$2.4 million annually. Additionally, an average of about \$550,000 annually would be used to address the following: (1) a demonstration dredging program to better determine the most efficient equipment and method of dredging, plus a reconnaissance evaluation of riverine placement; (2) monitoring of water quality impacts and coordination with the States and EPA on development of consistent criteria for sediment and water quality; (3) computer modelling of sediment transport, study of sediment control on the Chippewa River, and development of technical relationships at the underwater deltas of tributary streams for downstream dredging needs; and (4) rehabilitation studies for critical backwater areas such as Weaver Bottoms and Spring Lake, providing lockage waiting areas for recreational craft to address capacity problems at Locks and Dams 2 and 3, and determining the need to repair or modify individual wing dams.

Not included in the first priority program are \$6 million additional in average annual costs for the Full GREAT I program. This program would include mainstem shoreline protection at locations designated by the GREAT I Fish and Wildlife Work Group, sanitary pump-out facilities at locks, and modification and extensive marking of wing dams.

Increases in overall benefits from the project would result from implementation of the recommended actions. The primary gains would be to fish and wildlife, recreation, and water quality values. The loss of prime fish and wildlife habitat to placement sites for dredged material would be significantly reduced.

#### The GREAT II Implementation Report

The Implementation Report for GREAT II identifies 72 recommended actions for implementation; 69 by the Rock Island District and three by the North Central Division. The District has ranked these actions into high, medium, and low categories with 39 as high priority, 17 as medium priority, and 16 as low priority.

Implementation of the high priority programs would require an increase of approximately \$2 million annually through at least FY 86. About \$900,000 annually is needed in the District's channel maintenance activities to bring more flexibility to dredge material disposal. This flexibility is needed for increased transport capability, improved site preparation, better return water control, revegetation, and mitigation for damaged environments. The remaining \$1.1 million average annual expenditure during this time frame would be used to (1) conduct advance planning of the Upper Mississippi River navigation system so that locks whose capacity will be exceeded can be studied in accordance with existing legislation, (2) study navigation effects on the Upper Mississippi River environment during the fall and winter, (3) conduct detailed pool-by-pool cross section surveys, and (4) complete the District Mississippi River recreation and resource master plan in a timely manner.

Implementation of the medium priority programs would require an additional increase of approximately \$4.5 million in one-time costs and \$0.5 million in annual costs. This additional expenditure would be used to (1) construct a mooring cell just north of Lock 22, (2) extend the upper and lower guidewalls at Locks 20, 19, and 22, (3) refine the existing two-dimensional sediment transport model to assess the effectiveness of regulatory structures near chronic dredging areas, (4) complete backwater alterations, (5) investigate a pilot project to determine the feasibility and environmental considerations of dredging in backwater areas, (6) increase annual recreation resource funding to assure appropriate funding for recreation management of the Upper Mississippi River, and (7) increase annual funding for restoration of recurrent dredge site regulatory structures.

To implement low priority programs, an additional \$11 million would be required predominantly for mitigation of sites where backwater areas have lost considerable habitat value. Also included in the low priority programs would be (1) the establishment of boat launching facilities (2) promotion of a litter "Take It Home" campaign, (3) initiation of a research and development program to determine equipment necessary for performing large-scale backwater alterations, (4) implementation of systematic surveys to locate and identify cultural resources in the GREAT II reach of the Upper Mississippi River, and (5) a study to determine the cumulative effects of increased industrial, municipal, residential, and recreational encroachment on fish and wildlife habitat.

#### CONCLUSIONS

Draft copies of the St. Paul and Rock Island District Implementation Reports were distributed for review to agencies that actively participated in the GREAT I and GREAT II studies. Comments received and responses and discussion of the comments are contained in the final copies of the Implementation Reports. The comments were valuable in development of the following conclusions.

Implementation of GREAT Recommendations - Funding to implement the GREAT recommendations will be integrated into the annual NCD budget request. These recommended actions will compete for funds, through the established budget ranking process, with other Corps and Federal programs. Implementation of the recommended programs would require additional funds for the St. Paul and Rock Island Districts totaling approximately \$5.0 million annually through at least FY 1986.

Water Quality Considerations - The Clean Water Act required extensive changes in operation and maintenance activities to protect water quality values. Section 404(b) requires an evaluation of individual proposed dredged material placement sites to comply with guidelines issued by the U. S. Environmental Protection Agency (EPA). Section 404(t) of the Clean Water Act requires the Federal Government to comply with State laws and regulations in the discharge of dredged material into navigable waters. One step in the procedure for compliance is obtaining a permit from the appropriate State agency. Problems have arisen with conditions attached to the permits by the State regulatory agencies. The Corps believes that environmental problems which can result from placement of dredged material in the Mississippi River relate more to physical impacts of placement than to water quality impacts since most of the material is essentially clean sand.

The GREAT reports recommend that EPA develop water quality criteria for dredging and material placement that would lead to adoption of uniform requirements by the States for dredged material placement.

The North Central Division Engineer has requested the Regional Administrator, Region V, EPA to establish objective criteria for water quality as it relates to dredged material placement for the Upper Mississippi River. These criteria would furnish the basis for further discussions with the involved States regarding conditions for State permits. The Corps intends to observe State requirements--and is legally bound to do so under Section 404(t).

Cost Considerations in Placement Site Selection - Before placing dredged material on a proposed site, the District will conduct a Section 404(b) evaluation. The District will consider the GREAT site as the primary site, but will evaluate alternative sites to determine if the GREAT site is justified, recognizing environmental, social, and economic factors. If the GREAT site is selected, it will be submitted to the EPA for approval. If the EPA disapproves the site or our 404(b) evaluation identifies a more appropriate site, the newly proposed site will be referred for consideration to the Districts ongoing site-selection forum (the interagency group continuing the GREAT Team's coordination role). This procedure will assure that site-specific recommendations are justified prior to implementation.

A comparison of channel maintenance costs prior to the GREAT studies with more recent costs would reflect not only changes resulting from GREAT, but also differences in the shoaling rates, differences in the dredged volumes during those years, and increased costs to comply with recent environmentally-oriented legislation. In an effort to reduce the costs of channel maintenance, while still complying with necessary environmental constraints, investigations of riverine placement have been initiated. This procedure would place clean dredged material in the deepest portion (thalweg) of the channel, where stronger currents can carry it downstream so that sediments will not collect in backwaters or cause undesirable shoaling. This method is thought to be particularly feasible in the GREAT II area. Additional studies must be conducted to determine where, when, and how placement can be accomplished using the river's existing sediment transport system, without undue environmental impacts. This method would retain the river sediment in its natural regime for transport through the river system.

#### Definition of Project Depth

The Corps has the authority to maintain the channel for 9-foot draft vessels. Historically, the Corps has dredged to a depth of 11 feet below low control pool to provide a stable channel for 9-foot draft vessels, and up to an additional 2 feet of advance maintenance to provide capacity for future shoaling. Low control pool is the minimum water surface elevation. It is determined by considering the maximum allowable drawdown downstream and zero flow conditions upstream. Concerns have been voiced that reducing dredging depths as recommended by GREAT I would threaten the safety of commercial navigation. The Corps believes reduced-depth dredging means simply that we would not in every case dredge the additional 2 feet of depth for advance maintenance. Reducing advance maintenance dredging

will be done where there will be no significant increases in frequency of dredging or impacts on navigation safety. The dimensions of the navigation channel exclusive of the advance maintenance will remain the same as originally authorized. Dredging depths at approaches to rigid structures such as locks, bridges, piers, or other potential safety hazards will be determined by technically supported safety criteria rather than dictated solely by a desire to minimize dredging quantities. The Corps of Engineers and the U. S. Coast Guard will cooperate in an investigation concerning the effects on safety of intermittent shallow underkeel clearances for barge tows in an irregular (natural) channel.

#### Corps Purchase of Land for Dredged Material Placement

The Corps has authority to purchase rights or land for placement of dredged material. Congress would be advised, through the budget process, of contemplated and actual purchases. It is the Corps' policy not to invoke eminent domain and acquire land by condemnation proceedings for this purpose.

#### Fleeting Areas

The GREAT Teams have discussed studies to assess the impacts of proposed and existing barge fleeting areas in the Upper Mississippi River; the results of the studies were proposed to be used in the consideration of permit applications for additional fleeting areas. District Engineers will continue to cooperate with the States to resolve problems of fleeting areas within current Corps of Engineers policies.

#### Coordination in the Field

Both the GREAT I and GREAT II Study Teams recommended that continuing forums be established for field coordination of dredging activities and placement site selection. The responsibility for decision-making would remain with the Corps of Engineers. However, the GREAT studies have demonstrated the value of the interdisciplinary approach to channel maintenance activities. The Corps seeks to avail itself of the expertise residing in other Federal agencies, State agencies, universities, and private consultants. Representatives of commercial navigation will also be encouraged to contribute their valuable knowledge and experience.

#### GREAT Recommendations Requiring Changes in Congressional Authorities

Almost all of the actions recommended for Corps of Engineers implementation can be implemented within presently available authorities. The primary recommendation which would require Congressional action is authorization of full Federal funding of projects on the Upper Mississippi River for recreation and fish and wildlife. The Corps presently has authority to accomplish these purposes in connection with the existing navigation project; however, cost sharing with a local sponsor is required. Because of the multi-State nature of the river, identification of a willing local sponsor has been difficult. Recommendations concerning this issue in the GREAT I and GREAT II reports would represent a change in national policy.

Issues of this type (policy issues as opposed to project feasibility determinations) are normally considered through the Army Civil Works Legislative Program. This process involves: (1) identification and analysis of legislative needs which require new or amending legislation, (2) "packaging" of such legislative needs into a summary "legislative program" for submission by the Army to the Office of Management and Budget (OMB) together with the Civil Works annual budget submission, and (3) drafting of legislation within the Office, Chief of Engineers to supplement each item in the OMB-approved legislative program for submission to Congress.

At this time of fiscal austerity, the North Central Division does not intend to recommend a change in national policy to provide full Federal funding of projects for recreation and fish and wildlife on the Upper Mississippi River. This item could be considered in future submissions to the Army Civil Works Legislative Program.

The GREAT reports also recommend that Congress provide a clearer definition of the channel depth to be provided for the Upper Mississippi River navigation project. The North Central Division believes the channel depth to be maintained by the Corps has been adequately defined by existing legislation and past maintenance practices and that additional congressional action is not needed.

#### GREAT Recommendations Deferred

The ranking of GREAT recommendations for Corps of Engineers action was done by the involved District Engineers; it was not part of the Team report. Recommendations for immediate implementation were selected using the criteria of urgency, financial resources, organizational resources, and the priorities of the new administration. No recommendations were considered to lack merit--those "deferred" simply failed in competition with recommendations judged to be more important or suitable at this time. As the objectives of some recommendations are achieved or as funds become available from other sources, these "deferred" recommendations will be reconsidered.

#### GREAT Recommendations for Other Agencies

Thirty-two recommendations of the GREAT I Team and twenty-four recommendations of the GREAT II Team were applicable to organizations other than the Corps of Engineers, such as the U. S. Fish and Wildlife Service, U. S. Environmental Protection Agency, the U. S. Coast Guard, the State recreation or environmental agencies, municipalities, county agencies, industry groups, and public interest groups. Through the established process for developing approved regional water resources plans, the Corps of Engineers will participate with the other involved agencies in monitoring implementation of all GREAT recommendations.

#### ACTION

Having reviewed the reports of the GREAT I and GREAT II Teams and the Implementation Reports of the St. Paul and Rock Island District Engineers, I have determined that I, as Division Engineer, North Central Division, U. S. Army Corps of

Engineers, will:

Support increased annual budgets for the St. Paul District and the Rock Island District to implement the first priority GREAT recommendations.

Request that the Region V Regional Administrator of the Environmental Protection Agency establish objective criteria for water quality as it relates to dredged material placement for the Upper Mississippi River.

Instruct the St. Paul and Rock Island District Engineers to consider the GREAT-identified placement site as the primary site when conducting Section 404(b) evaluations for proposed dredging actions.

Support the St. Paul and Rock Island District Engineers in their investigations of riverine thalweg placement of clean dredged material.

Instruct the St. Paul and Rock Island Districts to continue to maintain the navigation channel for 9-foot draft vessels consistent with past definition of the channel. Advance maintenance dredging will be minimized consistent with vessel safety and maintenance cost considerations.

Support the St. Paul and Rock Island District Engineers in the purchase of land rights--from willing sellers--for placement of dredged material where it is clearly in the best interest of the river resources.

Instruct the St. Paul and Rock Island Districts to continue to cooperate with the States in the establishment and permitting of barge floating areas in accordance with Corps of Engineers policies.

Instruct the St. Paul and Rock Island District Engineers to continue the spirit of cooperation and coordination developed during the GREAT studies through the establishment of ongoing river management forums.

Take no action at this time to propose a change in national policy to provide full Federal funding of projects for recreation and fish and wildlife on the Upper Mississippi River.

Insure an annual reevaluation of those GREAT recommendations not being scheduled for implementation at this time.

#### RECOMMENDATION

I recommend the reports of the District Engineers be provided to Congress for its information.



#### REVIEW PROCESS AND ADDITIONAL PUBLIC INPUT

In accordance with law, these reports are being referred for review to the Board of Engineers for Rivers and Harbors in Fort Belvoir, Virginia. Interested parties may present written views to the Board. Statements submitted should not repeat material previously presented at public meetings held by the District or Division Engineers, or contained in their reports, as this information is already available to the Board. Information submitted should be new, specific, and bear directly on the findings in the report.

Written communications should be mailed to the Board of Engineers for Rivers and Harbors, Kingman Building, Fort Belvoir, Virginia 22060, in time to reach the Board by 24 August 1981. If extension of this date is considered necessary, a written request stating reasons for additional time desired should be mailed to the Board as soon as possible after receipt of this notice. Information furnished by mail is considered just as carefully by the Board and carries the same weight as that furnished at public meetings.

Copies of information received by mail will not be furnished to other parties. However, such information will be regarded as public information (unless the correspondent requests otherwise) and may be inspected by other interested parties in the office of the Board.

The Board will not take final action on the report until after expiration of this notice, or any extension thereof that may be granted, and full consideration of all information submitted in response thereto. Should the Board contemplate action materially different from the recommendations of the Division Engineer, appropriate notice to that effect will be furnished to local interests directly concerned, inviting their views and comments prior to final action.

#### FURTHER INFORMATION

Further information may be obtained from this office or for information specific to the GREAT I Study, from the District Engineer, St. Paul, 1135 U. S. Post Office and Custom House, St. Paul, Minnesota 55101; or for information specific to the GREAT II Study, from the District Engineer, Rock Island, Clock Tower Building, Rock Island, Illinois 61201. Copies of the implementation reports are available, without cost, upon request to the District Engineer, St. Paul or Rock Island, until the limited supply is exhausted.

You are requested to give the foregoing information to any persons known by you to be interested in this report and who did not receive a copy of this public notice.

Thank you for your continued interest.

Sincerely,

  
SCOTT B. SMITH

Brigadier General, USA  
Commander and Division Engineer

NCDPD (July 1981) 1st Ind

31 July 1981


SUBJECT: GREAT I and GREAT II (Upper Mississippi River Resource Management

DA, North Central Division, Corps of Engineers, 536 South Clark Street,  
Chicago, Illinois 60605

TO: Cdr, USACE (DAEN-CWP-C), WASH DC 20314

I recommend that the implementation reports of the District Engineers for GREAT  
I and II, and the inclosed public notice summarizing the two studies, be  
provided to the Congress for its information.

Inclosure  
Public Notice

  
SCOTT D. SMITH  
Brigadier General, USA  
Commanding

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## IMPLEMENTATION FOR THE GREAT I STUDY

### INTRODUCTION

#### RELATIONSHIP TO GREAT I REPORT

The GREAT I report describes the work and findings of the GREAT I interagency team which studied management problems of the Upper Mississippi River from Minneapolis-St. Paul, Minnesota, to Guttenberg, Iowa. It forms the basis for this implementation report, which is St. Paul District's plan for implementation of those GREAT I recommendations for which the Corps of Engineers was identified by the GREAT I Team as the lead agency.

This report provides the St. Paul District's perspective on the findings of GREAT I. It is being submitted through the organizational review channels of the Corps for approval and submission to Congress. The data and documents of the GREAT I report should be referred to for further details on the information discussed in this report. The principal aspect of river management discussed in this report is maintenance dredging of the 9-foot navigation channel along the Mississippi River and tributaries upstream of Guttenberg and management problems which result from this dredging. The St. Paul District intends to continue the spirit of cooperation and coordination developed during the GREAT I study. District activities on the river will be fully coordinated with the appropriate Federal and State agencies and the public.

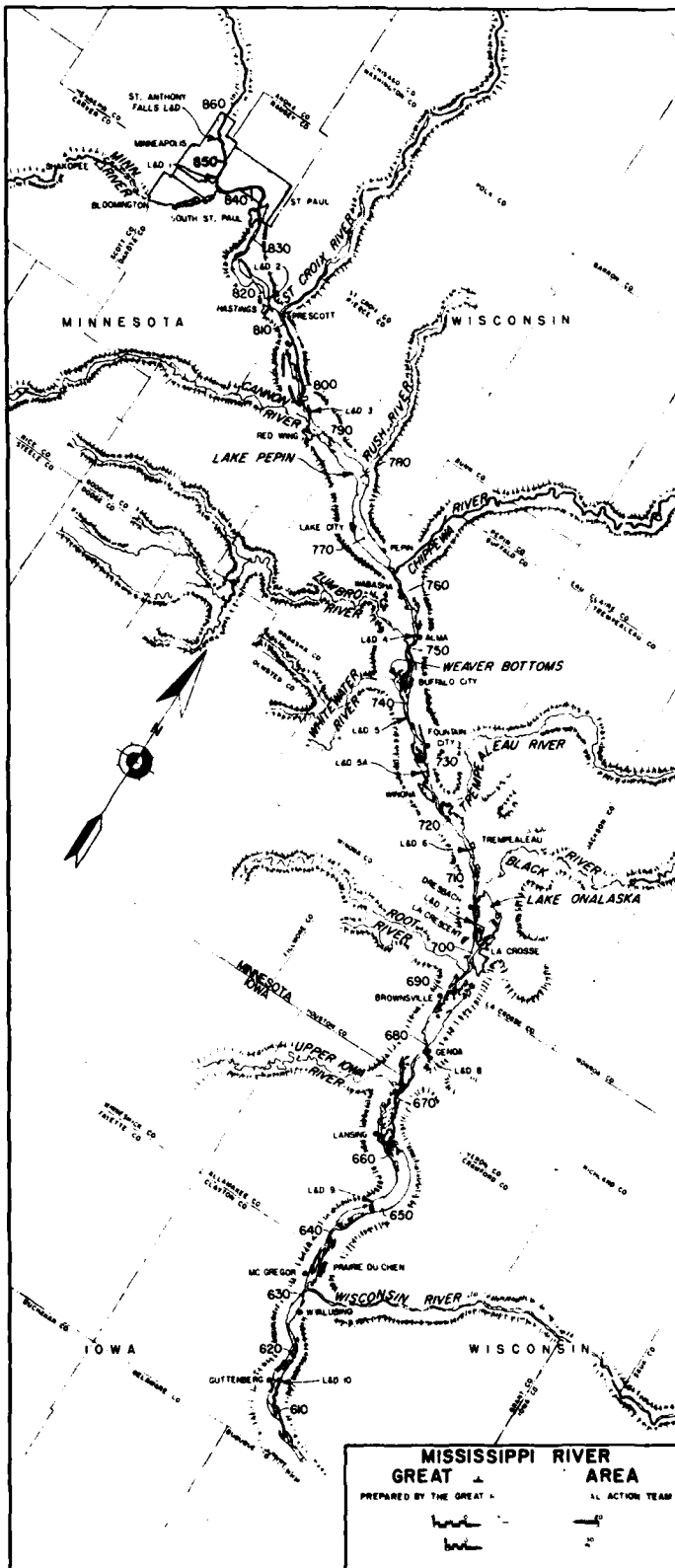
#### STUDY AUTHORITY

The principal authority for the GREAT I report and this implementation report is contained in Section 117 of the Water Resources Development Act of 1976:

"The Secretary of the Army, acting through the Chief of Engineers, is authorized to investigate and study, in cooperation with interested States and Federal agencies, through the Upper Mississippi River Basin Commission the development of a river system management plan in the format of the 'Great River Study' for the Mississippi River from the mouth of the Ohio River to the head of navigation at Minneapolis, incorporating total river resource requirements including, but not limited to, navigation, the effects of increased barge traffic, fish and wildlife, recreation, watershed management, and water quality at an estimated cost of \$9,100,000."

#### SCOPE OF THE STUDY

The study area is shown on figure 1 on page 3. It covers the Upper Mississippi River within the St. Paul District: from the head of navigation at Minneapolis (Cairo river mile 857.6) to Guttenberg (Cairo river mile 614). The lower 24.5 miles of the St. Croix River, lower 14.7 miles of the Minnesota River, and lower 1.4 miles of the Black River are also included. The main navigation channel and adjacent floodplains are the main study areas. Major tributaries and their watersheds are also addressed based on their sediment producing relationships to the Mississippi River. The study area is unique in that for approximately 150 miles the navigation project and the Upper Mississippi River Wild Life and Fish Refuge coexist.



The principal task of the GREAT I study was to develop a detailed channel maintenance plan and recommendations for the management of the river corridor. Other tasks included investigation of ways to reduce dredging volumes, containment or stabilization of dredged material placement sites, identification of productive uses for dredged material, evaluation of the compliance of dredging activities with Federal and State water quality and floodplain management standards, determination of equipment needed to maintain the river resources in an environmentally sound manner, and evaluation of recreation and fish and wildlife problems and needs.

The scope of this report is to address those components of the GREAT I report identified for Corps of Engineers implementation responsibility and most particularly those actions associated with the channel maintenance dredging.

#### STUDY PARTICIPANTS AND COORDINATION

The GREAT I study was conducted by an interagency team with representatives from the following States and Federal agencies: Iowa, Minnesota, Wisconsin, U.S. Department of Interior - Fish and Wildlife Service, U.S. Department of Agriculture - Soil Conservation Service, U.S. Department of the Army - Corps of Engineers, U.S. Department of Transportation - Coast Guard, U.S. Environmental Protection Agency, Minnesota-Wisconsin Boundary Area Commission (nonvoting), and Upper Mississippi River Conservation Committee (nonvoting).

The team was an equal member partnership, with representatives of the Corps of Engineers and Fish and Wildlife Service serving as cochairmen. It operated under the bylaws of the Upper Mississippi River Basin Commission. The studies of GREAT I were coordinated extensively with all levels of government and the public throughout the study area. The St. Paul District's representatives were professionals from varied backgrounds associated with water resource management (including civil engineering,



water resource planning, geography, hydrology, biology, social sciences, archeology, and other disciplines). Similar representation was provided in the compilation and preparation of this report.

This report was coordinated in draft form with GREAT I member agencies, representatives of the commercial navigation industry, and other State agencies with an interest in the GREAT I report. Comments received and responses to and discussion of these comments are found in Appendix F.

#### STUDIES OF OTHERS

Several major study efforts concerned with the Mississippi River in the GREAT I study area are under way or have been recently completed. The level B studies of the Upper Mississippi River Basin Commission, Corps of Engineers recreation and resource management planning, and other studies are important to consider when reviewing the findings of GREAT I and this report. Perhaps the more significant study efforts inter-related with GREAT I are the studies being conducted in GREAT II and GREAT III which cover those segments of the Upper Mississippi River in the Rock Island and the St. Louis Districts of the Corps of Engineers, respectively. GREAT II and GREAT III are operating under the same authority, funding, and framework as GREAT I.

The Upper Mississippi River Basin Commission Comprehensive Master Plan Study is also significantly related to the GREAT I study. This master plan study is developing a plan to guide management and development decisions especially as they concern expansion of the navigation system on the Upper Mississippi, Illinois, and Kaskaskia Rivers. The findings of the GREAT I study are available for incorporation in the master plan.

## PROBLEM IDENTIFICATION

### GENERAL

The problem identification process could be more appropriately called conflict identification. The river serves many interests, and each interest has different demands. What is best for one use may conflict with another. Identification of these conflicts is the first step toward solution of the problems.

### NATIONAL OBJECTIVES

Problem identification and alternatives evaluation during GREAT I followed the Water Resources Council's Principles and Standards for Planning Water and Related Land Resources. The overall purpose of the planning was to promote the quality of life along the Upper Mississippi River by reflecting society's preferences for attainment of the following two national objectives:

1. Enhancement of national economic development by increasing the value of the Nation's output of goods and services and improving national economic efficiency.
2. Enhancement of environmental quality through management, conservation, preservation, creation, restoration, or improvement of the quality of certain natural and cultural resources and ecological systems.

### FUTURE "WITHOUT" CONDITION

The future "without" condition is the most likely future condition in the study area if the major recommendations and findings of the GREAT I study are not implemented. It is developed to provide a base against which to measure changes anticipated from implementation of the recommended actions. The future "without" condition is basically a continuation of the existing uses of the river with increases in commercial navigation traffic, increases in recreation use, decreases in the quality of the fish and wildlife habitat, and some improvements in water quality.

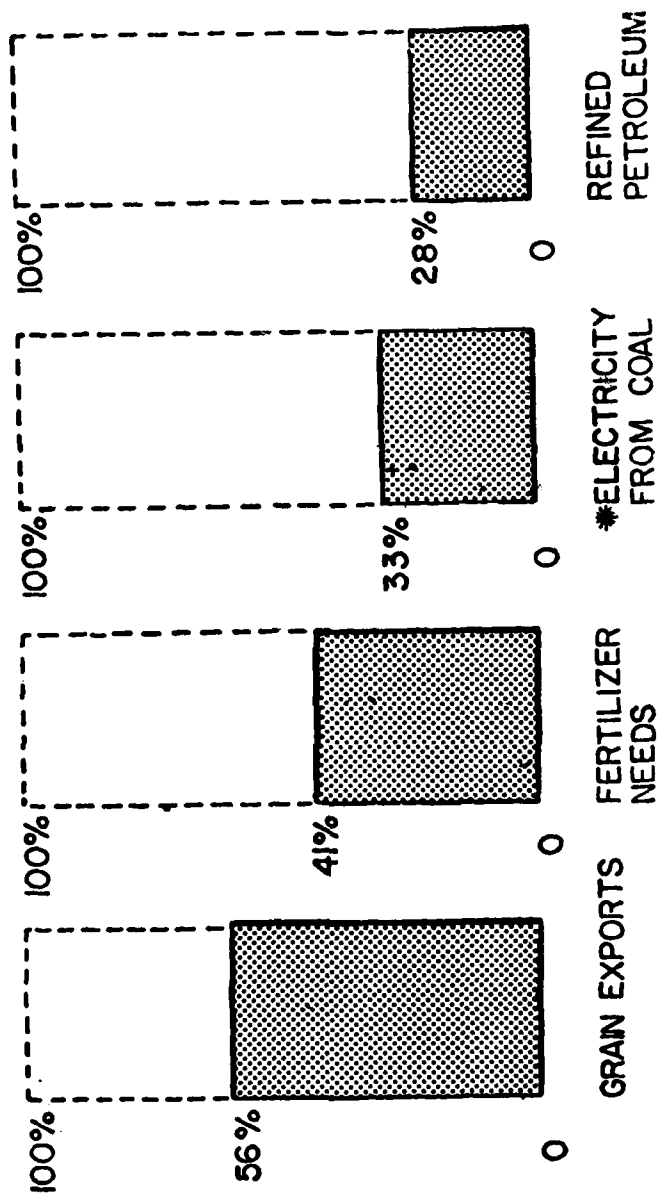
Some of the GREAT I recommendations would be implemented; however, confrontations would probably continue, and the conflicts between users of the river resource would increase in magnitude and frequency unless some positive actions are taken to resolve the issues.

#### PROBLEMS, NEEDS, AND OPPORTUNITIES

The problems, needs, and opportunities were addressed according to the following resource management areas.

##### Commercial Navigation

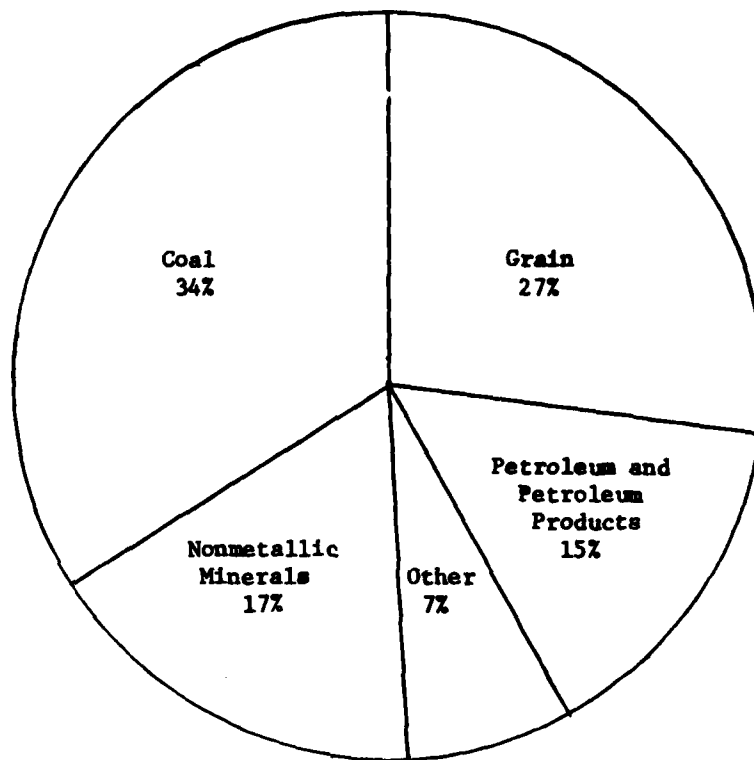
The inland navigation system in the GREAT I area is a vital link in our national intermodal transportation system. Commodities shipped on the 9-foot channel are important to the life and economy of the Upper Midwest. Figure 2 shows the percent of the area's commodities handled by barge transportation in the GREAT I area. The types of commodities handled are the bulk commodities; grain and coal account for the largest tonnages shipped. Figure 3 and table 1 show relative distribution of products shipped through the GREAT I area in 1977, which is fairly typical of recent years.



Percent of Area Commodities Handled by Barge Transportation on the Upper Mississippi River in the GREAT I Area. (Source: Upper Mississippi Waterway Association Study, 1975)

\* People receiving electricity from barged coal.

FIGURE 2



Total Shipments and Receipts Within the GREAT I  
Area, 1977

FIGURE 3

Table 1 - Total shipments and receipts within the GREAT I area, 1977

Commodity	Shipments	Receipts
	(thousands of tons)	
Coal	2,306.6	4,894.6
Grain	5,620.0	9.1
Nonmetallic minerals	1,616.0	1,977.3
Petroleum and petroleum products	1,388.3	1,761.7
Chemicals and related products	25.3	897.5
Metallic ores	48.5	254.4
Stone, clay, cement	0	252.3
Total	11,004.7	10,046.9

The benefits generated by this system are substantial. Transportation savings of grain and coal are significant. Table 2 shows the typical savings for a 15-barge tow of grain and coal traveling from or to St. Paul at 1979 rates.

Table 2 - Relative shipment costs of grain and coal from (grain) and to (coal) St. Paul

Item	Grain <sup>(1)</sup>	Coal <sup>(2)</sup>
	(\$1,000)	(\$1,000)
One-barge tow (15 barges)	160	150
Railroad (225 jumbo hopper cars)	570	220
Cost savings for barge tow	410	70

(1) Figures for grain are based on shipment of 787,500 bushels of grain at 1979 rates from St. Paul to New Orleans.

(2) Figures for coal are based on the shipment of 22,500 tons of coal at 1979 rates from the eastern and midwestern mines to St. Paul. Barge costs include costs for rail from the mines to St. Louis, transfer costs from rail to barge, and barge costs from St. Louis to St. Paul.

SOURCE: Commercial Transportation Appendix, GREAT I.

Waterway commerce has continued to exceed growth predictions and the system still has capacity to handle a greater level of commerce. The locks in the St. Paul District are used only about 40 percent and are idle about 60 percent of the time. Commercial transportation traffic represents about 70 percent of current time of lock use; recreational and other craft account for the remainder. The number of lockages for commercial and recreational craft are about equal; however, the time involved in locking recreational craft is much shorter. Tables 3 and 4 present information on lock use for the GREAT I area. Present fleeting areas for commercial barge traffic are marginally sufficient to handle the large volume of barges using the system. Problems are anticipated in the location of additional fleeting areas to handle traffic increases.

Table 3 - Percent of available time that locks within the GREAT I area are dedicated for use by type of traffic

Date	Percent of dedicated use			Total dedicated use	Total idle
	Commercial	Recreation	Other		
1975 (April- November)	27.6	9.4	0.7	37.7	62.3
1976 (April- November)	27.7	12.0	0.6	40.3	59.7
1979 (April- November)	26.7	9.9	0.6	37.2	62.8
1980 (April-July)	27.1	10.9	0.5	38.5	61.5
Average	27.3	10.5	0.6	38.4	61.6

SOURCE: St. Paul District Performance Monitoring System Data.

Note - information for 1977 and 1978 is not available at this time.

Table 4 - Number of commercial and recreational lockages by lock in the GREAT I area for 1978

Lock and dam	Total lockages	Total commercial lockages	Percent of total	Total pleasure boat lockages	Percent of total	Total pleasure boats through locks
USAF	2,480	1,517	61	963	39	1,670
LSAF	3,232	2,193	68	1,039	32	1,873
1	4,285	2,362	55	1,923	45	4,543
2	4,935	2,617	53	2,318	47	7,316
3	5,992	2,505	42	3,487	58	11,278
4	5,626	2,619	47	3,007	53	7,517
5	4,842	2,477	51	2,365	49	6,510
5A	5,580	2,548	46	3,032	54	7,232
6	5,119	2,629	51	2,490	49	5,734
7	6,351	3,074	48	3,277	52	9,415
8	4,952	2,807	57	2,145	43	5,339
9	5,027	2,842	57	2,185	43	3,929
10	<u>6,185</u>	<u>2,827</u>	46	<u>3,358</u>	54	<u>8,509</u>
Total for system	64,606	33,017	51	31,589	49	82,865

SOURCE: St. Paul District Performance Monitoring System data

#### Fish and Wildlife

The Upper Mississippi River system is a nationally and internationally significant resource for fish and wildlife. In the GREAT I reach, the river corridor contains over 275,000 acres of diverse, high quality aquatic and terrestrial habitats. The Upper Mississippi Wild Life and Fish Refuge covers the lower half of the study reach. Also in the area are the Trempealeau National Wildlife Refuge and all or parts of 10 State wildlife management areas.



The Upper Mississippi River and its associated backwater lakes, ponds, and sloughs support an exceptionally diverse and productive fishery. The fish most commonly sought by anglers include walleye, bluegill, crappie, catfish, sauger, white bass, and largemouth bass. Catfish, carp, buffalo, and freshwater drum are the primary commercial species. From 1953 to 1977, the commercial fish harvest in the GREAT I reach averaged 5.6 million pounds annually. No comprehensive areawide survey has been conducted on the sport fishery, but research on individual pools indicates substantial angler pressure.

The river corridor supports a multitude of wildlife, including mammals (59 species), birds (300 species), reptiles (28 species), and amphibians (15 species). However, the corridor is most noted for its value to waterfowl, both as a nesting area and migration route. The river valley lies in the heart of the Mississippi Flyway and is a migration route for hundreds of thousands of waterfowl and other bird species.

Construction of the locks and dams system and filling of the navigation pools in the 1930's created large areas of optimum habitat for fish and aquatic and semiaquatic wildlife. These conditions still exist in many areas; however, natural processes and human actions are degrading these optimum conditions.

The navigation pools are, in effect, shallow reservoirs, and the natural processes of erosion and sedimentation are slowly filling in the pools. This trend is especially evidenced in backwater areas where lakes and deeper marshes are being converted to shallow marshes as sediment accumulates. Sedimentation has been accelerated by land-use practices that have caused excessive erosion in upland areas.

Other factors that have led to degradation and deterioration of the habitat quality and fish and wildlife resources of the river include:

1. Loss of habitat to dredged material placement.
2. Secondary movement of dredged material into adjacent habitats.

3. Bed load sediment entering the backwater areas.
4. Increased recreational activity on the river.
5. Increased industrial and commercial development along the river and in the watershed.

Many of the natural processes occurring along the river cannot be halted. However, with proper management, adverse effects on the resources of the river can be slowed or mitigated. The effects of man's actions on the river's fish and wildlife resources can be controlled to a certain extent with coordinated planning and management by all agencies involved.

#### Recreation

Over 3 million people live along the Mississippi River in the GREAT I area, and over 8,000 boats are housed in marinas and private slips along the river. The river is used extensively for boating, hunting, fishing, and camping; dredged material islands and beaches receive heavy use.

A significant portion of today's recreational activity results from the improved navigation opportunities for pleasure craft and improved fish and game habitat resulting from the higher water levels created by the locks and dams. The 9-foot channel project provides water surfaces ideally suited for water-associated recreation. In addition to a deeper navigation channel, 13 pools or man-made lakes were created, extending for a distance of about 224 miles and forming many marshes, swamps, open sloughs, backwater sloughs, intermediate small lakes, and large open expanses of varying depths.

Within the pools are many islands some of which were created by placement of material dredged from the main channel. Most of these islands are very popular with recreational boaters and are used for picnics, swimming beaches, and camping areas.

Recreational travel can be broken down into two components: intrapool and interpool. The majority of the dredged material island users are intrapool users who trailer their boats close to their intended destinations and generally do not go through the locks. Interpool users may be traveling from the pool where they moor their boats to another pool where they recreate, or they may be on extended trips along the river. Table 5 summarizes estimated water-based recreation activities by pool for the 1980 season.

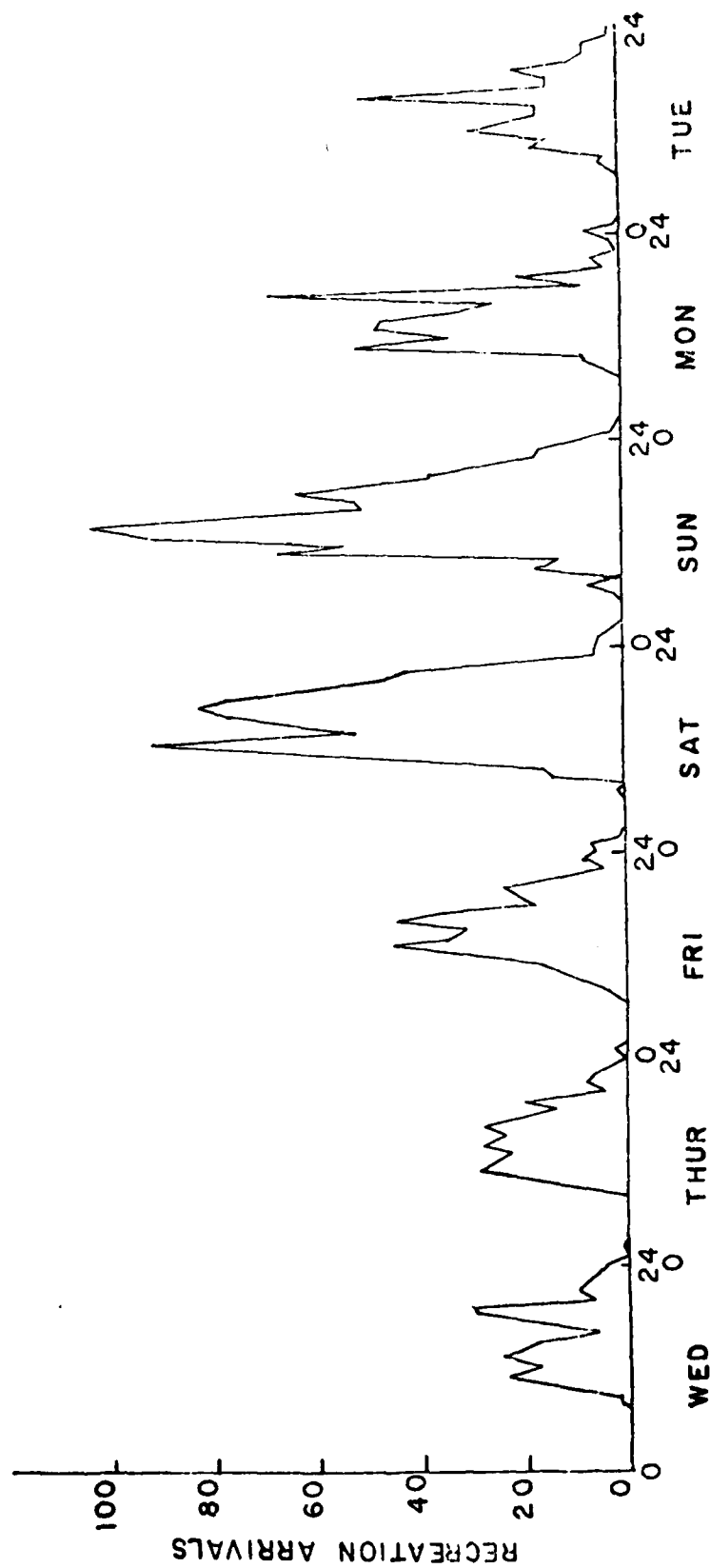
Table 5 - Water-based recreation activity occasions by pool in GREAT I area for 1980<sup>(1)</sup>

Pool	Activity occasions
Upper and Lower St. Anthony Falls	81,000
1	85,000
2	65,000
3 <sup>(2)</sup>	3,310,000
4	1,120,000
5	299,000
5A	367,000
6	1,140,000
7	536,000
8	658,000
9	783,000
10	<u>592,000</u>
Total	9,036,000

(1) Summarized from Volume 6, Recreation Appendix, GREAT I Report.

(2) Includes the St. Croix River.

Demand for water-based recreation fluctuates through the week, peaking on Saturdays, Sundays, and holidays. Use of lock 5A for one July week in 1976 is shown in figure 4. This peaking phenomenon has meant delays for both commercial and recreation craft.



Arrival Times of Recreational Craft at Lock 5A in July 1976 (plotted on an hourly basis)

FIGURE 4

The Corps of Engineers and other agencies operate many public use areas along the river. These areas range from 1 to 12 acres and include parking lots, boat ramps, and picnic and camping facilities. The locks and dams attract several thousand sightseers each year. Observation platforms have been provided at many of the locks and dams so visitors can view the operations.

Recreational use on the Upper Mississippi River has occurred, to a great extent, without an overall management plan. Federal, State, and local agencies have development and management capabilities but are not coordinated. Much of the recreational use that takes place on the river is because the natural resources are of high quality. However, in some areas, increased recreational pressure is degrading the resource base. One of the necessary management needs is to maintain a high quality resource base in the face of mounting recreational use.

#### Sediment and Erosion

One of the most pervasive and damaging problems for the Upper Mississippi River is erosion of fine sediments from upland areas. Since creation of the locks and dams in 1939, about one-fourth of the open water area has been converted to marshland.

Bed load sediment which comes from bank erosion on tributary streams also causes major problems when it settles in the navigation channel and requires dredging. The Chippewa River is the largest contributor of bed load sediment to the Mississippi River in the GREAT I area and is the source of the large volumes of material dredged from pool 4 below Lake Pepin. Bed load sediment from other tributaries, such as the Root and Zumbro Rivers, also contributes to shoaling problems that necessitate dredging in the navigation channel. Shifting of bed material, secondary movement of dredged material, and tow prop wash also contribute to shoaling.

### Floodplain Management

Man has encroached on and is working and living in the natural floodplain of the Upper Mississippi River. The three States regulate development in the floodplain. However, the limits of the floodplain and the regulation of development is not uniform. The definition of the floodway is not consistent among the agencies, making it difficult for the States and Federal agencies to agree on what, in fact, is encroachment on the floodway. These inconsistencies cause major difficulties in evaluating the effects of actions along the river. The effects of the placement of dredged material on flood stages would be an example; the St. Paul District and the States disagree on the magnitude of the effect based in part on the methodology, assumptions, and definitions used in analyzing the effects.

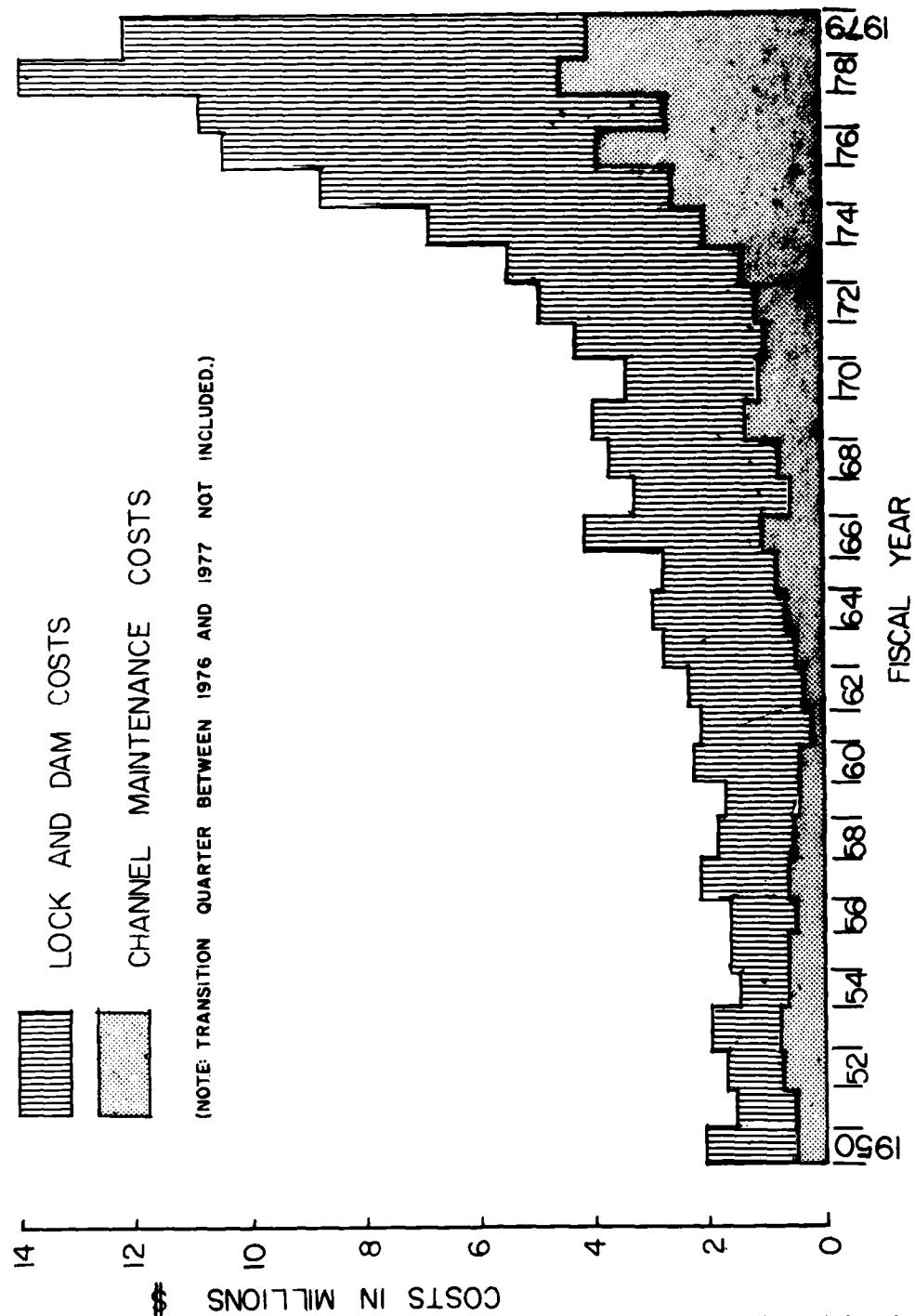
### Water Quality

The quality of water in the river directly affects the quality of life along the river. Pollutants come from discharges of wastewater, oil and chemical spills, and upland and streambank erosion. Once pollutants are in the system, they can be resuspended through wind and wave action, dredging operations, and passage of commercial and recreational craft.

Criteria for water quality in relation to placement of dredged material in the GREAT I area do not exist and are needed. The lack of criteria causes differences in the estimated effects of dredging activities on the quality of the main channel and backwater areas and in the evaluation of which measures are necessary to reduce adverse effects on water quality. Hazardous materials are carried on the waterway and on the highways and railroads adjacent to the waterway. The potential for spills of these materials exists.

### Channel Maintenance

Operation and maintenance of the 9-foot channel project in the St. Paul District consists of two basic components: operation of the locks and dams and channel maintenance. The costs of project operation and maintenance for fiscal years 1950 through 1979 (including the separation of the lock and dam costs and the channel maintenance costs) are shown in figure 5. The costs in 1979 were \$12.2 million, with 70 percent (\$8.5 million) for locks and dams and 30 percent (\$3.7 million) for channel maintenance. Appendix E provides additional detail on the costs.



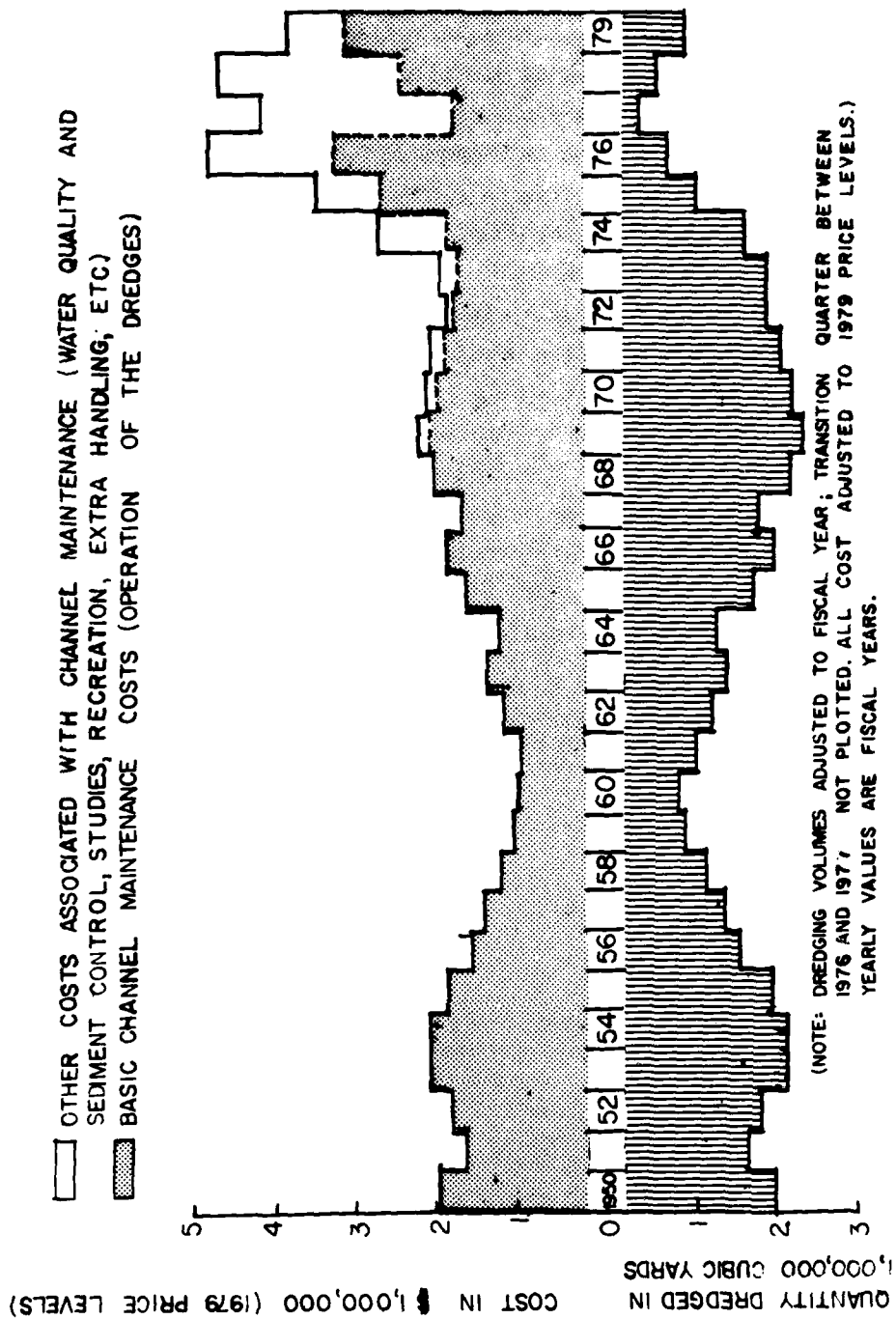
GREAT 1 STUDY  
ST. PAUL DISTRICT IMPLEMENTATION REPORT  
UPPER MISSISSIPPI RIVER

OPERATION AND MAINTENANCE COSTS  
9 FOOT CHANNEL PROJECT  
1950-1979

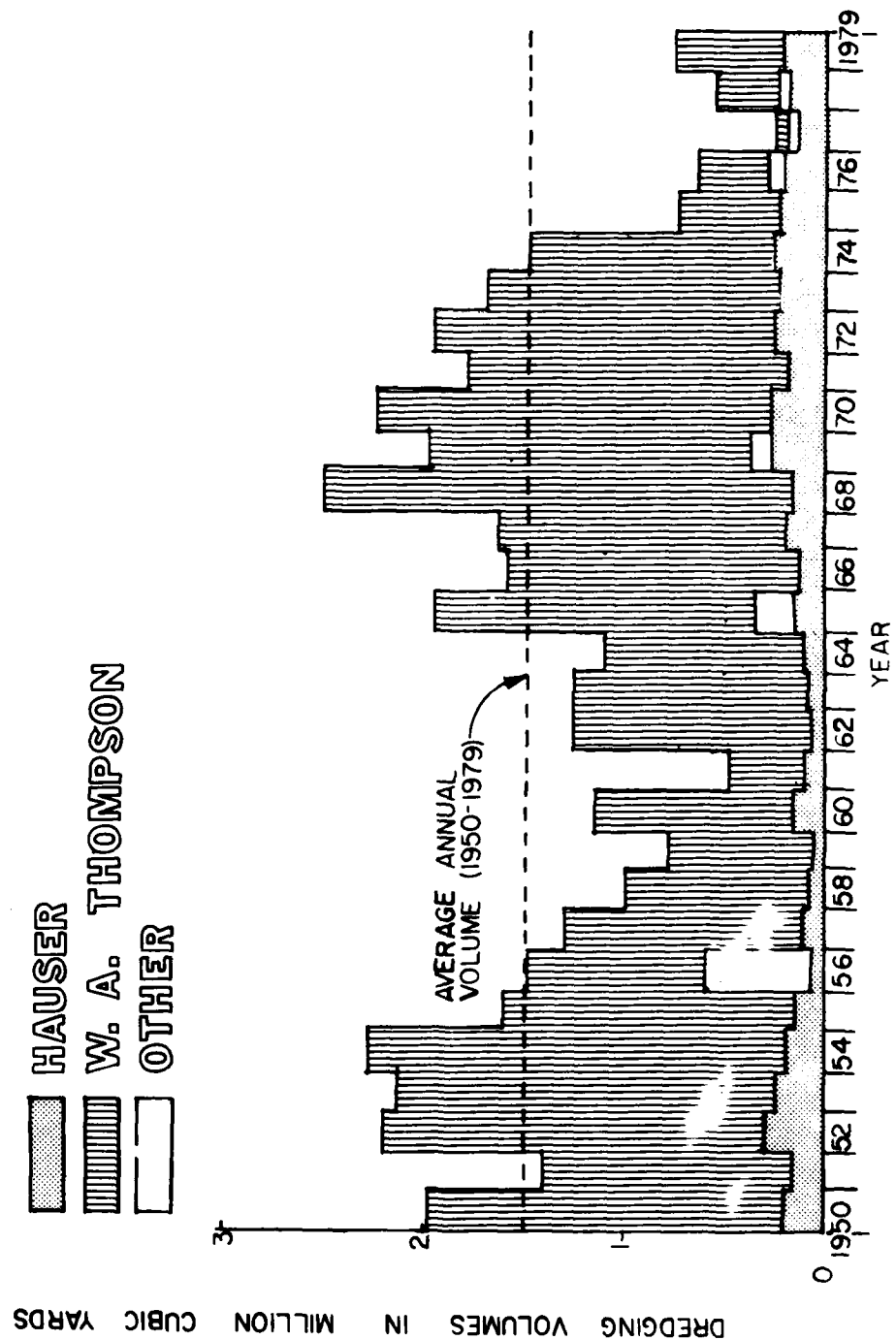
US ARMY, CORPS OF ENGINEERS FIGURE 5



The costs of channel maintenance before 1973 were closely related to the volumes of material dredged, as illustrated in figure 6. However, from 1974 through 1979, there has not been a good, consistent relationship primarily because of changes in channel maintenance operations and increases in costs resulting from compliance with Federal environmental quality laws. Extra costs for compliance amount to about 17 percent of the total operation and maintenance costs from 1975 through 1979. Most of the channel maintenance dredging in the St. Paul District has been accomplished by the large hydraulic dredge, William A. Thompson, and a mechanical dredge, the Derrickbarge Hauser. Figure 7 shows the volume of material dredged in the St. Paul District by each dredge from 1950 through 1979. The Thompson has dredged the majority of the material. The Hauser and other dredges have accounted for about 20 percent of the material handled. The dredged material is generally a clean sand suitable for beaches, road sanding in the winter, fill, and levee construction. However, most of the historic placement sites have not been near identified uses.



GREAT I STUDY  
 ST. PAUL DISTRICT IMPLEMENTATION REPORT  
 UPPER MISSISSIPPI RIVER  
 DREDGED VOLUMES AND  
 CHANNEL MAINTENANCES COSTS  
 1950-1979  
 US ARMY. CORPS OF ENGINEERS FIGURE 6



GREAT I STUDY  
ST. PAUL DISTRICT IMPLEMENTATION REPORT  
UPPER MISSISSIPPI RIVER

CHANNEL MAINTENANCE DREDGING  
IN ST. PAUL DISTRICT BY DREDGES  
1950-1979

US ARMY. CORPS OF ENGINEERS      **FIGURE 7**

## PLANNING CONSTRAINTS

Constraints on the planning conducted in the GREAT I study consisted of recognition of Federal and State laws that apply to activities in the study area. The continued operation and maintenance of the 9-foot channel project and the continuation of the Upper Mississippi River Wild Life and Fish Refuge were accepted as a part of the future conditions. Several Federal environmental quality statutes have required significant changes in the St. Paul District's operation and maintenance of the 9-foot channel project. Some of the more significant statutes are:

1. National Environmental Policy Act of 1969.
2. Endangered Species Act of 1973.
3. Preservation of Historic and Archeological Data Act of 1974.
4. Clean Water Act of 1977.

### National Environmental Policy Act of 1969

In its most elementary interpretation, this statute requires Federal agencies to fully consider the protection and enhancement of environmental values in carrying out their programs. In operation and maintenance of the 9-foot channel, this involves minimizing adverse impacts and enhancing environmental values as much as practicable while still ensuring a safe, navigable channel. Requirements of this act include public and agency review of project actions and alternatives, preparation of environmental documents, and identification and assessment of actions that could be taken to avoid or minimize adverse impacts.

### Endangered Species Act of 1973

This act requires that federally listed endangered or threatened species and their critical habitats be protected. Compliance with this act involves conducting species surveys, coordinating with appropriate Federal and State agencies, and modifying actions if necessary to avoid impacts on these species.

#### Preservation of Historic and Archeological Data Act of 1974

This act requires that the cultural resources of all land and water areas affected by the project be evaluated and that steps be taken, if necessary, to protect such resources. Complying with this act requires evaluation of cultural resources, surveys, coordination efforts, and protective or mitigative actions necessary if the project has adverse impacts on cultural resources.

#### Clean Water Act of 1977

The Clean Water Act of 1977 probably requires the greatest changes in operation and maintenance to protect environmental values, specifically water quality. Section 404(b) requires an evaluation of dredged material placement activities to ensure compliance with guidelines promulgated by the U.S. Environmental Protection Agency. These guidelines are designed to ensure the protection and maintenance of water quality for all uses. Compliance with Section 404(b) requires studies, testing, and other data collection needed for the evaluations and measures to minimize the adverse effects of placement. There is some overlap between National Environmental Policy Act requirements and Section 404(b) requirements.

Section 404(t) requires that Federal agencies comply with State laws and regulations in the placement of dredged material. The process of compliance involves obtaining permits from appropriate State agencies. In the State of Minnesota, the Corps must obtain State permits to place dredged material below the ordinary high-water mark and discharge effluent from a contained placement site. Wisconsin requires a permit for effluent discharge from a contained placement site, and Chapter 30.12 of the Wisconsin Administrative Code prohibits placement of material below the ordinary high-water mark. In the State of Iowa, a permit is required to place material below the ordinary high-water mark. No permit is required for discharge of effluent from a contained placement site, although the State does require that discharged effluent be monitored.

Problems have arisen with respect to the conditions imposed by State regulatory agencies. These problems involve specific requirements of the permits and the fact that different States have different requirements.

The Corps believes that the basic environmental problems which can result from the placement of dredged material in the Mississippi River relate more to the physical impacts of placement than to water quality impacts because most of the material is essentially clean sand. It also believes that water quality conditions imposed by the States in some instances do not have a sound ecological basis and do not consider physical impacts as do the guidelines used in the evaluations conducted under Section 404(b).

#### PLANNING OBJECTIVES

The objective of the GREAT I study was to develop a total river resource management plan for the river corridor from Minneapolis-St. Paul to Guttenberg. A principal subobjective was the development of a plan to maintain the 9-foot navigation channel in an environmentally sound manner, recognizing existing Federal and State laws and all resource values in the formulation of the plan.

#### RECOMMENDATIONS OF GREAT I

The GREAT I report presents many recommendations for future improvements in the management of the Upper Mississippi River in the GREAT I area. The recommendations cover 11 management areas and are presented in 3 categories for implementation: action items, policy and funding items, and further study items. Table 6 (beginning on page 32) summarizes the recommendations. In the first column, the recommendations are summarized by category. The lead agency is identified in the second column. Of the 112 recommendations, 80 are directed to the Corps of Engineers for lead agency implementation responsibility. A complete description of the recommendations and the rationale for each recommendation is presented in the GREAT I main report. Appendix A of this report also presents information on the recommendations.

## IMPLEMENTATION CONCLUSIONS

### GENERAL

During the review of the GREAT I recommendations, the implications of the recommendations to the Corps of Engineers operation and maintenance activities for the 9-foot channel project and other related activities were assessed. Three potential alternative future programs were considered: (1) Basic Program, (2) First Priority Program, and (3) Early Implementation of GREAT I Program (GREAT I Program).

The Basic Program was considered a base-line condition for future operation and maintenance activities at funding levels, equipment capabilities, and practices similar to current operations or with reasonably foreseeable modifications. The GREAT I recommendations would be incorporated to the extent practicable using the funding and equipment constraints imposed. This projection would be considered essentially the future "without" condition.

The First Priority Program was the program that would allow incorporation of those recommendations of GREAT I which are important and necessary to accomplish the principal objectives of GREAT I. Policy and funding level changes would be required. However, on the basis of information obtained through the GREAT I process, the St. Paul District feels that the actions required to implement the First Priority Program are justifiable and the District will actively support recommendations to implement them. As additional information is obtained, specific features of the recommended actions may need to be modified; however, achieving the objectives of the program would be the overall goal.

The GREAT I Program is the program that would allow full implementation of all GREAT I recommendations at an early future date. A detailed description of the degree of potential implementation of each GREAT I recommendation under either the Basic, First Priority, or GREAT I Program is presented in Appendix A. The key features of each of the programs are summarized below. All costs are at 1979 price levels. Appendix B contains additional information on the GREAT I CMP and equipment needs, Appendix C dredging requirements, Appendix D environmental effects of implementation of GREAT I recommendations, and Appendix E economic considerations of operation and maintenance.

## BASIC PROGRAM

The Basic Program would provide for continued operation and maintenance of the 9-foot channel on the basis of the justification for commercial navigation with provisions for fish and wildlife and recreation as incidental considerations. The Dredge Thompson, Dredge Dubuque, and Derrickbarge Hauser would be the principal Corps-owned dredges used for channel maintenance. Contractor dredging would be considered when supplemental equipment is required and funding levels are sufficient. The dredged material placement sites proposed for use would be evaluated in detail considering economic and environmental effects. The recommended GREAT I placement sites would be evaluated as the principal sites; however, alternative sites would be considered. Easements or fee title acquisition of some placement sites would be required. Interagency coordination would be continued through the channel maintenance forum and on-site inspection teams. Reductions in dredging quantities would be considered using the guidelines recommended by GREAT I (including sediment transport and transportation safety considerations). Appropriate State permits for the dredged material placement sites would be applied for. Recreation and fish and wildlife work would continue on a limited basis.

The estimated average annual cost of the Basic Program is about \$19.2 million. Recognizing average annual commercial navigation benefits of about \$25.8 million, the benefit-cost ratio is 1.3. Consideration of the annual recreation and fish and wildlife benefits of about \$12.7 million would provide a benefit-cost ratio of 1.9.

## FIRST PRIORITY PROGRAM

The First Priority Program would provide for continued operation and maintenance of the 9-foot channel project in a manner similar to that of the Basic Program; however, additional consideration would be given to fish and wildlife, recreation, and water quality through implementation of the GREAT I Channel Maintenance Plan and other GREAT I recommendations. The Derrickbarge Hauser, another mechanical dredge (either government- or contractor-owned), and the Dredge Thompson would probably be the principal dredges used to maintain the channel. Detailed evaluation of



dredged material placement sites would continue; the GREAT I recommended site and alternative sites would be considered. Rights to place dredged material on private property, either through easement or fee title, would be needed at several locations. Equipment analysis, dredging equipment demonstration projects, riverine thalweg placement, tributary sediment control measures, and other evaluations of maintenance dredging related actions would be conducted to identify justifiable modifications to channel maintenance dredging. Actions to benefit recreation and fish and wildlife would be accomplished in a somewhat higher level than under the Basic Program.

The estimated average annual cost of the First Priority Program is about \$22 million. The benefit-cost ratios would be 1.2 and 1.7 when considering commercial navigation benefits only or commercial navigation plus fish and wildlife and recreation benefits, respectively. The benefits for fish and wildlife would increase over estimates made for the Basic Program; however, these increases are not presently quantifiable and are not included in the comparison of benefits and costs.

#### GREAT I PROGRAM

The GREAT I Program would provide for continued operation and maintenance of the 9-foot channel project in a similar manner as the First Priority Program; however, fish and wildlife and recreation values would receive additional emphasis. The dredging equipment and practices would be similar to those in the First Priority Program; however, floodplain, water quality, and other effects of the operation and maintenance of the project would be analyzed. Changes in congressional authorities to provide for full Federal funding for enhancement of recreation and fish and wildlife through the navigation project funding would be required. Congressional action to provide additional definition of the project would also be required, although this additional definition would not be expected to result in any changes in the operation and maintenance of the project.

Implementation of all GREAT I recommendations directed to the Corps of Engineers would result in an average annual cost of about \$28 million. The benefit-cost ratios would be 0.9 and 1.3 when considering the Basic Program level of benefits for commercial navigation only or benefits for commercial navigation, recreation, and fish and wildlife, respectively. The benefits to fish and wildlife and recreation would be greater than those used in the comparison; however, these increases are not quantifiable at this time.

#### CONCLUSION

On the basis of the extensive study and coordination accomplished by the GREAT I Team, the GREAT I report and recommendations represent a substantial step forward in total resource planning. The St. Paul District analyzed the GREAT I report and recommendations with additional consideration of economic and environmental values and has assigned relative priorities to the actions identified for Corps of Engineers implementation responsibility.

Many of the GREAT I recommendations are being implemented or can be implemented in the near future as part of ongoing programs. The St. Paul District concludes that implementation of the GREAT I recommendations to the level covered in the First Priority Program is fully justified and clearly in the best interest of the public. The St. Paul District's program for implementation of the GREAT I recommendations is described in table 6 (page 32). Information presented includes the overall relative priority the District places on the recommendations, the general programs and approaches to implementation of the recommendations, estimated costs for implementation, and authorities under which the recommendations would be implemented. Many GREAT I recommendations were directed to agencies other than the Corps of Engineers and the program in table 6 describes only the actions the St. Paul District plans to implement.

Implementation of this program represents an average annual increase in costs of about \$3 million. However, the benefits to fish and wildlife, recreation, and water quality are believed to exceed the expenditures,

even though the increase in benefits is not quantifiable at this time. Funding to implement these recommendations would be best integrated into the annual operation and maintenance budget.

#### RECOMMENDATION

I recommend that the actions described in the First Priority Program as described in this report and summarized in table 6 be approved and funded in an orderly manner and according to the priorities established.

WILLIAM W. BADGER  
Colonel, Corps of Engineers  
District Engineer

Table 6 - Summary of St. Paul District implementation plans for GREAT I recommendations

St. Paul District implementation plans					Authority (4)
Recommendation (1)	Lead agency	Relative priority	Program (2)	Estimated cost (3)	
Action Item 1 Implementation of Channel Maintenance Plan (CMP)	Corps	High	Conduct detailed evaluation of GREAT I and alternative information and request funds and necessary approvals to implement the CMP, recognizing that the CMP can be modified through coordination.	\$2,400,000 annually (5)	RHA's 1930, 1932, 1958 NEPA, CWA EO 11988, 11990, and 11593 FWCA, ESA, NHPA WRDA 1976 FCA 1944 and 1962 FWPRA
Action Item 2 Use of interim guidelines for channel maintenance	Corps	High	Follow guidelines to extent practicable within capability and funds.	Would range between present cost and the cost shown for the CMP (Action Item 1) ;	Same as Action Item 1.
Action Item 3 Establish and restore main stem shoreline protection	Corps	Low	Protect shoreline only at those sites considered most likely to reduce channel maintenance costs or stabilize the navigation channel.	\$400,000	RHA's 1930, 1932, 1958 FWCA, NHPA
Action Item 4 Minimize average annual dredging quantities	Corps	High	Reduce the volume of material dredged where the costs of channel maintenance and impacts on commercial navigation are not significant. Evaluations would be made on a site-by-site basis.	Included in the cost of the CMP (Action Item 1).	NEPA, CWA
Action Item 5 Efficient dredging equipment should be purchased	Corps	High	Analyze equipment to determine the most appropriate equipment mix, including consideration of contract dredging.	Included in the cost of the CMP (Action Item 1).	NEPA, CWA, FWCA

Table 6 - Summary of St. Paul District implementation plans for GREAT I recommendations (cont)

St. Paul District implementation plans				
Recommendation (1)	Lead agency	Relative priority	Program (2)	Estimated cost (3)
Action Item 6 Analyze effects of in-floodplain placement of dredged material	Corps	Medium	Develop and use HEC-2 model to analyze effects of dredged material placement on flood stages.	\$100,000
Action Item 7 Place dredged material where it can be used beneficially	Corps	High	Identify potential users of dredged material and, where reasonable, provide material to them.	EO 11990, FWCA, NEPA, WRDA 1976
Action Item 8 Provide for use of temporary placement sites	Corps	High	Temporary placement sites would be used only when necessary, and the GREAT I guidelines for their use would be followed as much as possible.	Included in the cost of the CMP (Action Item 1).  Same as Action Item 1.
Action Item 9 Criteria for sediment and water quality related to dredging should be developed	Corps, EPA, States	High	EPA and regulatory agencies would be encouraged to develop criteria. Data collection would be continued. Dredging operations would be monitored. Contaminated dredged material would be contained.	\$50,000  NEPA, CWA
Action Item 10 Prepare site development plans for placement sites	Corps	High	Site development plans would be prepared for the proposed placement sites and many of the more important historical sites.	Included in the cost of the CMP (Action Item 1).  WRDA 1976, NEPA, CWA EO 11988, 11990, 11593 NAPA, FWCA, ESA, FCA 1944 and 1962 FWPRA
Action Item 11 Study and implement sediment control measures on the Chippewa River.	Corps	High	Alternatives would be evaluated. Pilot dredging and monitoring of a sediment trap at the mouth of the Chippewa River would be implemented as part of the evaluation.	\$600,000  HPWCR 1969

Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations (cont.)

St. Paul District Implementation plans					Authority
Recommendation (1)	Lead agency	Relative priority	Program (2)	Estimated cost (3)	
Action Item 12 Increase application of soil erosion control measures	SCS	N/A	The implementation of this program by the SCS and States is endorsed.	N/A	N/A
Action Item 13 Monitor and regulate hazardous materials on river	EPA, DOT	N/A	The Corps would cooperate with the action agencies in the monitoring of shipment of hazardous material.	N/A	N/A
Action Item 14 Install sanitary pump-outs and trash pick-up facilities	Corps, FWS	Medium	Trash collection facilities near lockage waiting areas would be provided for a trial period.	\$12,000 annually	CWA FCA 1944 and 1962 FWPRA
Action Item 15 Staff and budget for fish and wildlife resource work should be increased	Corps, FWS, States	Medium	Staffing and funding would be increased as appropriate when considering the prevailing national policies on these issues.	N/A	FWCA, NEPA, EO 11990
Action Item 16 Install culverts at lock and dam 4	Corps	Low	Plans for the culverts would be coordinated with appropriate agencies.	\$10,000	FWCA, NEPA
Action Item 17 Install culverts at lock and dam 10	Corps	Low	Plans for the culverts would be coordinated with appropriate agencies.	\$10,000	FWCA, NEPA
Action Item 18 Upgrade facilities of Upper Mississippi Wild Life and Fish Refuge	FWS	N/A	No Corps action planned.	N/A	N/A

Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations (cont)

St. Paul District Implementation plans				
Recommendation (1)	Lead agency	Relative priority	Program (2)	Estimated cost (3)
Action Item 19 Maintain primitive recreational use sites.	Corps	Medium	Maintenance of primitive recreation use sites would be considered when placing material.	Included in the costs of the CMP and placement site development plans. FCA 1944 and 1962 FWPRA, NEPA
Action Item 20 Develop lockage waiting areas	Corps	Medium	Lockage waiting areas would be provided on a trial basis.	\$500,000 RHA 1930, 1932, 1958 FCA 1944, 1962 FWPRA
Action Item 21 Provide detailed uniform recreational facility guides	Corps, FWS, States	Medium	Leadership would be provided in the development of these guides.	\$50,000 Same as Action Item 19.
Action Item 22 Provide uniform and/or upgraded signing of recreation areas	Corps, FWS, States	Medium	In coordination with the FWS, the need for uniform signing on Federal lands would be determined.	Included in the cost of Corps RRMMP (6) Same as Action Item 19.
Action Item 23 Hazardous control structures should be marked	Corps	Low	An inventory of wing dams and closing dams, an evaluation of those considered to be hazardous, and the experimental marking of several would be accomplished.	\$100,000 plus \$10,000 annually Same as Action Item 19.
Action Item 24 Adopt and enforce uniform noise levels	States, Local	N/A	No Corps action planned.	N/A N/A
Action Item 25 Provide a bikeway along the Great River Road	Corps, FWS	Low	No Corps action planned.	N/A Same as Action Item 19.

Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations (cont)

St. Paul District Implementation plans					Recommendations (cont.)
Recommendation (1)	Lead agency	Relative priority	Program (2)	Estimated cost (3)	Authority (4)
Action Item 26 Develop a system of canoe trails	Corps, FWS	Medium	Coordination with the F&WS to consider the development of limited canoe trail plans and facilities.	\$20,000	Same as Action Item 19.
Action Item 27 Open the Fort Snelling back channel	Corps	Low	The ongoing feasibility study would be completed. If the plan is economically feasible and a willing non-Federal sponsor agrees to local cooperation requirements, implementation funds would be requested.	\$130,000 <sup>(8)</sup>	RHA 1960
Action Item 28 Intensify educational efforts on boating safety and "rules of the road"	Corps, FWS, DOT, States	Medium	The distribution of information and safety brochures would be continued.	N/A	Same as Action Item 19.
Action Item 29 Intensify educational efforts on boating safety, navigation, and hazards of the river	DOT, Boating clubs	N/A	Programs to educate boaters on potential hazards of the river would be continued.	N/A	N/A
Action Item 30 Rental agencies should brief their clients on safe boating procedures	States, Local	N/A	No Corps action planned.	N/A	N/A
Action Item 31 Water patrol staff should be increased	FWS, DOT, States, Local	N/A	Cooperation with water patrol enforcement personnel would be continued.	N/A	N/A



Table 6 - Summary of St. Paul District implementation plans for GREAT I recommendations (cont)

St. Paul District implementation plans				
Recommendation (1)	Lead agency	Relative priority	Program (2)	Estimated cost (3)
Action Item 32 Encourage "packing out" of trash	Corps, FWS, States	Low	Existing and future brochures would have sections dealing with maintaining clean land and water through "packing out" of trash.	N/A
Action Item 33 Produce detailed topographic and hydrographic maps	USGS	N/A	The Corps would coordinate existing data, photos, and other available information with the USGS.	N/A
Action Item 34 Water resource projects on tributaries should address potential changes to flows and sediment.	Corps, SCS	Medium	Any proposed Corps projects on tributaries would address the effects where the potential would be measurable.	NEPA, EO 11988 \$10,000 per project (8)
Action Item 35 Develop information and education programs on Upper Mississippi River	UMRBC	N/A	The Corps would cooperate with the UMRBC.	N/A
Action Item 36 An interagency management coordination team should be continued	Corps, FWS, EPA, DOT, SCS, States	High	Corps participation would continue in the Channel Maintenance Coordination Forum. Memorandums of understanding would be considered to formalize the forum.	Included in the cost of the CMP (Action Item 1).
Action Item 37 An On-Site Inspection Team and a channel dimensions review committee should function in the future	Corps, FWS, EPA, DOT, SCS, States	High	Corps participation and leadership on this committee and team would be continued.	Included in the cost of the CMP (Action Item 1).

Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations (cont)

St. Paul District Implementation plans				
Recommendation (1)	Lead agency	Relative priority	Program (2)	Estimated cost (3)
Action Item 38 Implementation of GREAT I should be monitored by the Minnesota-Wisconsin Boundary Area Commission	MWBAC	N/A	The Corps would cooperate with the MWBAC in its monitoring activities.	N/A
Action Item 39 A total river resource management plan should be developed	Corps, FWS, EPA, DOT, SCS, States, UMRBC	Medium	The Corps would provide available data, information, and technical expertise to assist the UMRBC in development of such a plan.	N/A
Policy/Funding Item 1 Maintenance of the navigation channel should continue consistent with other resource requirements	Corps, Congress	High	The Corps will continue to operate and maintain the navigation channel consistent with the funding levels and authorities provided by the Congress.	Estimated \$22,000,000 average annual cost (9)
Policy/Funding Item 2 Long-term plans should be prepared to implement the CMP	Corps	High	The Corps would develop long-term plans to implement the CMP, including modifications which may result through further detailed evaluations.	Included in the cost of the CMP (Action Item 1).
Policy/Funding Item 3 Definition of emergency dredging and imminent closure	Corps, States	High	Formal agreements with appropriate agencies are being pursued for 1981. Additional coordination will be pursued for future years to develop a consistent definition for entire Upper Mississippi River.	N/A

Same as Action Item 1.

Same as Action Item 1.

Same as Action Item 1.

Same as Action Item 1.

Table 6 - Summary of St. Paul District Implementation Plans for GREAT I recommendations (cont)

Recommendation (1)	Lead agency	Relative priority	St. Paul District implementation plans		
			Program (2)	Estimated cost (3)	Authority (4)
Policy/Funding Item 4 St. Paul District should maintain dredging capability for emergency and national defense needs	Corps	High	The St. Paul District plans to have the Dredge Thompson or a comparable dredge available for emergency channel maintenance dredging needs.	N/A	Same as Action Item 1.
Policy/Funding Item 5 Sell dredged material to sand and gravel companies	Corps	Low	Sand and gravel companies would be notified of material availability.	N/A	Same as Action Item 1.
Policy/Funding Item 6 Private lands should be acquired as necessary to implement the CMP	Corps	High	Approval to acquire easements or fee title rights for placement sites required to implement the CMP would be requested. Easements would be the preferred acquisition method.	Included in the cost of the CMP (Action Item 1).	Same as Action Item 1.
Policy/Funding Item 7 Laws and requirements should be modified	Corps, States	High	Coordination and cooperation with States and other Federal agencies would be continued to facilitate mutually agreeable changes to the various laws and requirements.	N/A	Same as Action Item 1.
Policy/Funding Item 8 Definition of the 9-foot channel project	Corps, Congress	Low	No Corps action planned.	N/A	N/A
Policy/Funding Item 9 Develop and implement a comprehensive plan for management of the wild life and fish refuge	FWS	N/A	Coordination with the FWS would be continued on development of management plans.	N/A	N/A

Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations (cont)

Recommendation (1)	Lead agency	Relative priority	St. Paul District Implementation plans		Authority (4)
			Program (2)	Estimated cost (3)	
Policy/Funding Item 10 Manage river as an ecological unit	Corps, FWS, States	Low	No specific action is planned. Coordination with the FWS and States would be continued for any plans along these lines.	N/A	FWCA, NEPA
Policy/Funding Item 11 Authority to Corps to assist in accomplishing fish and wildlife conservation and recreation projects	Corps, Congress	Medium	Existing authorities and cost-sharing policies would be used. New authorities or policies could be proposed through the Army civil works legislative program. Full cooperation would be provided toward implementation if this authority and new cost-sharing policy are provided.	N/A	FWCA, FWPRA, WRDA 1976
Policy/Funding Item 12 Show recreation and fish and wildlife features as separate line items in the budget	Corps	Low	Recreation and fish and wildlife features would be shown as separate items in St. Paul District's submission to Chief of Engineers.	N/A	FWCA, FWPRA
Policy/Funding Item 13 Beneficiary/user data should be developed	Corps, FWS	Medium	User data and potential cost allocations would be developed consistent with the Chief of Engineers' policies.	\$20,000	Same as Action Item 1.
Policy/Funding Item 14 Unified management objectives should be developed for each pool	Corps, FWS, States	Low	Participation in the development of these objectives would be provided as needed. Higher priority will be provided for Federal land management.	N/A	Same as Action Item 1.
Policy/Funding Item 15 Organisms not native to Upper Mississippi River corridor should be evaluated for compatibility	FWS, States	N/A	No Corps action planned.	N/A	N/A

Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations (cont)

St. Paul District implementation plans					Authority
Recommendation (1)	Lead agency	Relative priority	Program (2)	Estimated cost (3)	
Policy/Funding Item 16 Scenic easements/ acquisitions should have a higher priority in conjunction with Great River Road	Federal Highway Admin.	N/A	This issue will be addressed to a limited degree for Corps- owned lands in the Corps recreation and resource manage- ment plan.	Included in the cost of 6 Corps RRMP.	N/A
Policy/Funding Item 17 Federal bridge laws over waterways should be amended	DOT	N/A	No Corps action planned.	N/A	N/A
Policy/Funding Item 18 Obstructive bridges should be rebuilt to provide adequate clearances	DOT	N/A	No Corps action planned.	N/A	N/A
Policy/Funding Item 19 Boathouse permits should be carefully controlled.	Corps, FWS, States	Medium	Regulatory control is being exercised.	N/A	RHA 1930, 1932, 1958 FWRRA, RHA 1899
Policy/Funding Item 20 Lockages should be monitored	Corps	Medium	Lockages will be monitored periodically. Actions will be taken to resolve problems which are identified.	\$10,000 annually	Same as Action Item 1
Policy/Funding Item 21 High impact recrea- tional development near valuable fish and wildlife areas should be discouraged	Corps, FWS	Medium	Potential impacts of recrea- tional development will be con- sidered in any associated Corps actions on a site-specific basis and through its regulatory program for private actions.	N/A	FVCA, CWA, RHA 1899

Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations (cont)

Recommendation (1)	Lead agency	Relative priority	Program (2)	Estimated cost (3)	Authority (4)
Policy/Funding Item 22 Cooperative inter-agency recreation surveys should be part of a recreation resource monitoring program	Corps, FWS, States	Medium	Levels of recreation monitoring on the river would be increased.	\$20,000 annually	Same as Action Item 19.
Policy/Funding Item 23 A diversity of recreational opportunities should be provided	Corps, FWS, States, UMRBC	Medium	The diversity of recreational resources and opportunities would be considered in the development of the Corps recreation and resource management plan.	N/A	Same as Action Item 19.
Policy/Funding Item 24 Publicly owned recreational boat launching accesses should be maintained	Corps, FWS, States	Medium	All boat landings on Corps-owned lands would be evaluated to determine future operation and maintenance plans.	Included in the cost of Corps RRMMP. (6)	Same as Action Item 19.
Policy/Funding Item 25 Uniform floodplain management standards should be developed	States	N/A	Development of uniform standards is endorsed. Technical assistance would be provided as available and as requested.	N/A	N/A
Policy/Funding Item 26 Guidelines of the Upper Mississippi River Basin Commission for monitoring of GREAT I recommendations are endorsed	UMRBC	N/A	The St. Paul District has prepared this report to forward the GREAT I report to organizational review levels, other agencies, and Congress.	N/A	N/A

Table 6 - Summary of St. Paul District Implementation Plans for GREAT I recommendations (cont.)  
St. Paul District Implementation plans

Recommendation (1)	Lead agency	Relative priority	Program (2)	Estimated cost (3)	Authority (4)
Further Study Item 1 Demonstration dredging projects should be accomplished	Corps	High	Demonstration dredging projects at several locations would be conducted to assist in defining suitability of certain equipment types for channel maintenance.	\$200,000	Same as Action Item 1.
Further Study Item 2 A plan should be developed to use the river's sediment transport capability	Corps	High	Plans would be developed at several sites where potential for successful application seems high.	\$150,000	Same as Action Item 1.
Further Study Item 3 Development of computerized sediment transport models should be continued	Corps	High	The one-dimensional model would be completed for most pools and the two-dimensional model would be calibrated at several sites. Both models would be used to evaluate alternatives to reduce dredging requirements.	\$200,000	Same as Action Item 1.
Further Study Item 4 Monitor deltas at tributaries and develop technical relationships at deltas	Corps	High	The delta of the Chippewa River would be monitored, and a technical relationship for the delta would be developed.	\$50,000 plus \$10,000 annually	Same as Action Item 1.
Further Study Item 5 Determine condition of wing dams and closing dams	Corps	High	Condition of all wing dams and closing dams at historic dredging sites would be determined. Evaluations of potential changes would be conducted at several sites.	\$400,000	Same as Action Item 1.
Further Study Item 6 Evaluate relationship between pool levels and dredging requirements	Corps	Low	No major evaluation of the relationship of pool levels (operational plan) and dredging requirements is programmed.	N/A	Same as Action Item 1.

Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations (cont)

Recommendation (1)	Lead agency	Relative priority	St. Paul District implementation plans		
			Program (2)	Estimated cost (3)	Authority (4)
Further Study Item 7 Investigate possibility of sand and gravel companies doing the dredging	Corps	Medium	Opportunities for sand and gravel companies to conduct their operations where it could reduce channel maintenance dredging would be explored with several companies.	\$30,000	Same as Action Item 1.
Further Study Item 8 Monitor dredging and material placement activities to determine water quality impacts	Corps, EPA	High	Water quality parameters would be monitored. The Corps would work with the EPA on development of water quality criteria for dredging when handling clean material.	Included in the cost of Action Item 9.	Same as Action Item 1.
Further Study Item 9 Analyze bank erosion control alternatives and develop authority and cost-sharing criteria	Corps, SCS	Low	The streambank erosion control demonstration program would be completed. No further Corps action is planned.	N/A	WRDA 1974
Further Study Item 10 Evaluate tributary bed load trapping structures on dry Wisconsin tributaries to pool 3.	Corps	Low	No action planned at this time.	N/A	Same as Action Item 1.
Further Study Item 11 Investigate riverine placement	Corps	High	Coordination would be maintained with the riverine placement activities in Rock Island District.	\$50,000	Same as Action Item 1.



Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations (cont)

Recommendation (1)	Lead agency	Relative priority	St. Paul District Implementation plans		
			Program (2)	Estimated cost (3)	Authority (4)
Further Study Item 12 Evaluate removal of dredged material at existing placement sites in the floodway	Corps	Low	The potential effects of proposed placement of dredged material on the flood stages would be evaluated. If significant effects are identified, alternatives to minimize flood stage impacts would be evaluated.	\$50,000	EO 11988
Further Study Item 13 Evaluate transporting dredged material to areas of high demand	Corps	Low	At several sites of apparent high demand and where it appears practical to provide the material, the feasibility of providing the material would be evaluated.	\$25,000	EO 11988, 11990 NEPA, CWA
Further Study Item 14 Encourage private enterprise to transport material to areas of high demand	Corps	Low	Information on the location and characteristics of dredged material would be provided to private enterprise.	\$5,000	N/A
Further Study Item 15 Evaluate manufacture of riprap from dredged material and cement	Corps	Low	No Corps action planned.	N/A	N/A
Further Study Item 16 Study potential beneficial uses of fine organic sediments	Corps	Low	Potential uses would be evaluated on a case-by-case basis; however, few studies are anticipated.	\$10,000	Same as Action Item 1.
Further Study Item 17 Evaluate conservation tillage	SCS, States	N/A	No Corps action is planned; however, the Corps would encourage the SCS and States to pursue this program.	N/A	N/A

Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations (cont)

St. Paul District Implementation plans					Estimated cost <sup>(3)</sup>	Authority <sup>(4)</sup>
Recommendation (1)	Lead agency	Relative priority	Program <sup>(2)</sup>			
Further Study Item 18 Expand monitoring program of sediment inflow from major tributaries	Corps	Medium	Corps involvement in the current sediment monitoring program would be reviewed to determine the appropriate level of such participation		\$20,000	Same as Action Item 1.
Further Study Item 19 Study protection of critical backwater areas	Corps, FWS	Medium	Technical input and review would be provided to the FWS.		\$30,000 <sup>(7)</sup>	FWCA, NEPA, WRDA 1976
Further Study Item 20 Evaluate island creation from dredged material	FWS	N/A	Technical input and review would be provided to the FWS.		N/A	FWCA, NEPA, WRDA 1976
Further Study Item 21 Evaluate Weaver Bottoms rehabilitation proposal	Corps, FWS, States	High	Feasibility studies to determine impacts of the proposal would be conducted, considering the relationship to the CMP and potential participation of the Corps in enhancement features.		\$50,000	FWCA, NEPA, WRDA 1976
Further Study Item 22 Investigate using "Finger Lakes" as a backwater management physical model	Corps, FWS	Low	Coordination would be maintained with the FWS and States.		\$10,000 <sup>(7)</sup>	FWCA, NEPA
Further Study Item 23 Reduce fine sediment flow into Big Slough	FWS	N/A	Coordination would be maintained with FWS and State of Iowa. The effect of various alternatives to reduce dredging requirements downstream of the inlet to Big Slough on sediment inflow into Big Slough would be evaluated.		\$20,000 <sup>(7)</sup>	N/A

Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations (cont)

St. Paul District implementation plans				
Recommendation (1)	Lead agency	Relative priority	Program (2)	Estimated cost (3)
Further Study Item 24 Investigate impacts of separation of Lake Onalaska from the main channel	Corps, FWS	Medium	Solutions to the problem and related impacts would be evaluated with FWS and State of Wisconsin.	\$25,000 (7)
Further Study Item 25 Study rehabilitation of Spring Lake	Corps	High	Alternatives to reduce dredging needs at the head of Spring Lake and their effects on the quality of Spring Lake would be evaluated.	\$75,000 (7)
Further Study Item 26 Continue monitoring program at Krueger Slough and Island 42	FWS	N/A	Coordination would be maintained with the FWS.	N/A
Further Study Item 27 Map submerged aquatic features	FWS	Low	Main channel border features in localized areas of lower pool 4 through, pool 10, including substrate data, would be mapped.	\$60,000
Further Study Item 28 Study controlling pool levels to benefit fish and wildlife	Corps, FWS	Medium	Potential pool level operational changes to benefit fish and wildlife in at least one pool would be analyzed.	\$15,000
Further Study Item 29 Identify and designate primitive and natural States areas	Corps, FWS,	Low	Coordination would be accomplished with the FWS and States on any proposals they consider.	N/A
Further Study Item 30 Consider forest management in the UMRBC master plan	UMRBC	Low	The Corps' recreation and resource management master plan would be coordinated with the UMRBC.	N/A

Authority (4)

FWCA, NEPA

FWCA, NEPA

N/A

N/A

FWCA, NEPA

FWCA, NEPA

N/A

Table 6 - Summary of St. Paul District implementation plans for GREAT I recommendations (cont)

Recommendation (1)	Lead agency	Relative priority	St. Paul District implementation plans		
			Program (2)	Estimated cost (3)	Authority (4)
Further Study Item 31 Study management techniques of bottomland hardwoods for wildlife	FWS	Low	Forestry management on Corps-owned lands would be addressed in the Corps recreation and resource management master plan.	Included in the cost of Corps RRMMP. (6)	N/A
Further Study Item 32 Study life history of fishes	FWS, States	N/A	No Corps action planned	N/A	N/A
Further Study Item 33 Place culverts and open side channels at Blackhawk Park	Corps, States	Low	Coordination would be continued with the State of Wisconsin and FWS to develop acceptable plans.	\$10,000	FWCA, NEPA
Further Study Item 34 Protect aesthetics of area	Corps, FWS, UMRBC	Low	Protection of aesthetics of Corps-owned land would be considered in the recreation and resource management master plan.	Included in the cost of Corps RRMMP (6)	FWCA, NEPA
Further Study Item 35 Review regulations pertaining to commercial navigation	DOT	Low	The Corps would cooperate with the DOT and other agencies in reviewing regulations.	\$15,000 (7)	N/A
Further Study Item 36 Identify acceptable fleeting areas	DOT	Low	The Corps would cooperate in the study of fleeting area needs.	N/A	N/A
Further Study Item 37 Mark a navigation channel through Lake Pepin	DOT	Low	As appropriate, the need for channel marking through Lake Pepin would be considered in the Corps recreation and resource management master plan.	Include in the cost of Corps RRMMP (6)	N/A

Table 6 - Summary of St. Paul District implementation plans for GREAT I recommendations (cont)

St. Paul District implementation plans				
Recommendation (1)	Lead agency	Relative priority	Program (2)	Estimated cost (3)
Further Study Item 38 Study capacity limitations at locks and dams 2 and 3	Corps	Low	Lockage waiting areas for recreational craft would be considered at lock 2 and 3.	See Action Item No. 20 RHA 1930, 1932, 1958
Further Study Item 39 Reassess needs of the Coast Guard to operate and maintain navigational aid system	DOT	N/A	The Corps of Engineers will co-operate with the Coast Guard and provide any appropriate support.	N/A
Further Study Item 40 UMRBC should coordinate a system recreation master plan	Corps, FWS, UMRBC	Medium	The Corps recreation and resource management master plan would be coordinated with the UMRBC.	N/A Same as Action Item 19.
Further Study Item 41 Study acceptability of development of recreation sites	Corps, FWS, States, UMRBC	Medium	Evaluation of specific recommendations will be considered in the development of the Corps recreation and resource management master plan.	Included in the Same as Action Item 19. cost of Corps RRMP. (6)
Further Study Item 42 Identify and zone areas of pools where water surface use conflicts exist	DOT, States	N/A	The Corps recreation and resource management master plan will identify areas of water use conflicts within the pools.	Included in cost of Corps RRMP. (6) N/A
Further Study Item 43 Evaluate private leases on Federal lands	Corps, FWS	High	Private leases on Corps-owned land will be reviewed for potential conflicts with public use of the lands.	N/A Same as Action Item 19.

Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations (cont)

St. Paul District Implementation plans				
Recommendation (1)	Lead agency	Relative priority	Program (2)	Estimated cost (3)
Further Study Item 44 Study suitability of mathematical models for floodplain management	Corps, UMRBC	Medium	The Corps would review proposals and evaluations by the UMRBC in its evaluation of floodplain management models.	N/A
Further Study Item 45 Inventory cultural resources	HCRS	N/A	A cultural resources literature search and survey would be conducted on areas affected by the 9-foot navigation project.	\$60,000
Further Study Item 46 Evaluate the Geographic Information System as a management tool	UMRBC	N/A	No Corps action planned.	N/A
Further Study Item 47 Document land ownership and management responsibility within the river corridor.	Corps, UMRBC	Medium	Land management responsibility on Corps-owned lands would be documented and ownership identified on potential dredged material placement sites.	Included in the cost of Corps (6) RRMP.
				Same as Action Item 19.

(1) The recommendations are summarized briefly. Their full texts and rationale can be found in the Volume 1, Main Report, GREAT I Report.

(2) The program as summarized represents the St. Paul District recommended actions toward implementation of each GREAT I recommendation. Additional detail and information on this program is contained in Appendix A under the First Priority Program.

Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations

Recommendation (1)	Lead agency	Relative priority	St. Paul District Implementation plans		Authority (4)
			Program (2)	Estimated cost (3)	

- (3) The cost estimates are based primarily on the estimated costs developed by the GREAT I Team. Some have been revised by the St. Paul District after additional evaluation. The costs are at 1979 price levels. The costs were developed only for the described program level of implementation for the St. Paul District. Where full implementation of the GREAT I recommendation is different than the recommended program, the costs for full implementation of GREAT I are not included. Other agency costs are also not included.
- (4) The authorities referred to are the statutory or executive authorities under which the actions would be implemented. The full identification of the authorities follows:

RHA 1930, 1932, 1958 - River and Harbor Acts of 1930, 1932, and 1958 - These acts are the enabling legislation for the Upper Mississippi River navigation project.

NEPA - National Environmental Policy Act (NEPA-42 USC 4321) - Requires Federal agencies to evaluate the effect which their actions will have on the environment and to give appropriate consideration to environmental values in the decision-making process

CWA - The Clean Water Act - Formerly the Federal Water Pollution Control Act, this law can affect dredging in two ways. Section 404(b) requires an evaluation of the impact of placing dredged material in navigable waters or adjacent wetlands. In evaluating these impacts, the Corps applies the Environmental Protection Agency (EPA) guidelines regulating the discharge of dredged or fill material which are set out in 40 CFR 230. Section 404(t) requires that the Corps comply with State regulatory requirements when placing dredged material.

EO 988 - Executive Order 11988 - Requires consideration of the impact of Federal actions on floodplain values.

EO 11990 - Executive Order 11990 - Requires consideration of the impact of Federal actions on wetland values.

EO 11593 - Executive Order 11593 - Requires the protection and enhancement of the cultural environment. Any significant resources are surveyed and, when appropriate, nominated to the National Register of Historic Places.

Table 6 - Summary of St. Paul District Implementation plans for GREAT I recommendations (cont)

Recommendation (1)	Lead agency	Relative priority	St. Paul District implementation plans	
			Program (2)	Estimated cost (3) Authority (4)
FWCA - Fish and Wildlife Coordination Act (16 USC 742) - Requires consultation with the U.S. Fish and Wildlife Service and State agencies.				
ESA - Endangered Species Act (16 USC 1531) - Prohibits the Corps from taking any actions that would jeopardize the existence of endangered or threatened species or would destroy or modify habitat which is determined by the Secretary of the Interior to be critical.				
NHPA -National Historic Preservation Act (16 USC 470) - Requires consideration of historical and archeological values in planning for dredging.				
WRDA 1976 - Water Resource Development Act of 1976 - Authorizes placement of sand at State-provided sites with any increased cost paid by local interests. Authorizes creation of wetlands by using dredged material from a water resource development project. Directs Corps to use best management practices to extend life of placement sites and minimize need for new sites.				
FCA 1944 - Flood Control Act of 1944 - Authorized recreation facilities at Corps reservoirs.				
FCA 1962 - Flood Control Act of 1962 - Amended 1944 Act to permit recreation development at nonreservoir projects.				
FWPRA - Federal Water Project Recreation Act (Public Law 89-72) - Requires consideration of opportunities for recreation and fish and wildlife enhancement. Requires non-Federal cost sharing if included as a project benefit.				
RHA 1960 - River and Harbor Act of 1960 - Section 107 established a special continuing authority for construction of small navigation projects.				
WRDA 1974 - Water Resources Development Act of 1974 - Section 32 established a national streambank erosion prevention and control demonstration program.				
HPWCR - House Public Works Committee Resolution, 11 December 1969 - Authorized a study of the flood and related problems in the Chippewa River basin.				



Table 6 - Summary of St. Paul District implementation plans for GREAT I recommendations (cont)

Recommendation (1)	St. Paul District implementation plans			Authority (4)
	Lead agency	Relative priority	Estimated cost (3)	

RHA 1899 - River and Harbor Act of 1899, Section 10 - Authorized the Department of the Army to regulate modifications to navigable waters.

- (5) In addition to present level of funding for maintenance of the navigation channel in the GREAT I area.
- (6) The cost of the St. Paul District recreation and resource management master plan is estimated at \$435,000.
- (7) This figure is only the St. Paul District's costs to participate with the other agencies in the conduct of the study.
- (8) These costs would not be covered by operation and maintenance funds, but would be part of the individual project evaluation.
- (9) The average annual cost figure includes the cost of operation and maintenance, and cost of rehabilitation of several locks, estimates of remaining economic value of existing structures, and costs of maintaining aids to navigation.

**APPENDIX A**

**PROGRAM OPTIONS FOR FUTURE OPERATION AND MAINTENANCE**

**UPPER MISSISSIPPI RIVER AREA  
(HEAD OF NAVIGATION TO GUTTENBERG, IOWA)**

**ST. PAUL DISTRICT  
U.S. ARMY CORPS OF ENGINEERS**

**JUNE 1961**

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## APPENDIX A

### PROGRAM OPTIONS FOR FUTURE OPERATION AND MAINTENANCE

#### INTRODUCTION

The program options presented in this report center around three concepts for Corps of Engineers implementation of the findings and recommendations of the GREAT I report: (1) Basic Program; (2) First Priority Program; and (3) Early Implementation of GREAT I Program. All options provide for continued operation and maintenance of the 9-foot navigation channel with varying degrees of implementation of GREAT I recommendations. The principal differences are the costs of implementation and the methods and data available in the development of the justification or benefits to be derived from implementation.

The actions discussed are primarily those for which the Corps has implementation responsibility. However, in areas where the principal responsibility of an action lies with another agency but completion of its action is essential to successful completion of a related Corps action, the relationship and relative significance to the Corps program and the three options will also be presented. The relative significance and priorities, if any, which may be assigned to the GREAT I recommendations are subject to change as additional information and studies are completed. Any program recommended for implementation must be flexible to accommodate changing future conditions. The Basic and First Priority Programs do not correspond exactly to any of the alternative plans described in the GREAT I reports. These programs are derived from the GREAT I approved recommendations and plans and are projected from 1979 base conditions attempting to implement as many of the GREAT I recommendations as practical within the constraints of the program. The GREAT I Program is a description of the necessary elements to fully comply with the program recommended by the GREAT I Team.

## **BASIC PROGRAM**

The Basic Program is considered a base-line condition for future operation and maintenance of the 9-foot channel in the St. Paul District. This program is considered the "future without" condition for comparison with the First Priority and GREAT I Programs. The program would consist of continuing the operation and maintenance at funding levels and with practices similar to current operations which ensure compliance with Federal laws. Some moderate increases in funding levels above increases resulting from higher price levels are included where the increases result from needed actions to comply with Federal regulations or where the actions are essential to continuation of the project.

The intent of this program would be to comply with and incorporate as many of the GREAT I recommendations as soon as funding and scheduling would allow. With the limited budget increases of this program, a priority list for the GREAT I recommendations would be established so that in low-volume dredging years the highest priority recommendations could be addressed and implemented.

## **FIRST PRIORITY PROGRAM**

The First Priority Program is that program which would allow implementation of the higher priority recommendations of GREAT I. This program would require higher funding levels than the basic program and is supported by the justification presented in this report and the GREAT I reports. The schedule for implementation of GREAT I recommendations would be accelerated from that presented in the Basic Program and has been programmed over about a 6-year time frame. However, it would not allow full and early incorporation of all GREAT I recommendations, the program should be reevaluated and updated.

## **EARLY IMPLEMENTATION OF GREAT I PROGRAM**

The GREAT I Program is the program that would be necessary to implement the plans and recommendations of the GREAT I Team as presented in the GREAT I report. Information given in the GREAT I report is used as the basis for

cost estimates, implementation schedules, and priorities to the extent possible. In the cases where information is not available in the GREAT I documents, supplemental information was developed to provide a reasonable basis for the estimates.

#### SUMMARY OF GREAT I RECOMMENDATIONS BY PROGRAM OPTIONS

The following table presents a discussion of each GREAT I recommendation by program option, discussing the proposed Corps actions for implementation of the appropriate components of the recommendations within the Basic, First Priority, and GREAT I Programs.

Table A-1 - Program actions proposed and/or needed to implement recommendations

GREAT I recommendation	Program	
	Basic	First Priority
<u>Action Item 1</u>		
The Corps of Engineers should implement the dredged material placement plan proposed by GREAT I.	<p>The St. Paul District will evaluate each GREAT placement site and alternatives, as appropriate, considering Federal laws and regulations and the feasibility of site use. Any proposed modifications to the Channel Maintenance Plan (CMP) would be fully coordinated with appropriate Federal and State agencies. Coordination would be initiated to obtain State permits for the placement sites as well as rehandling sites and methods to allow use of the final placement site. The approval and funding to acquire easements or purchase sites and necessary access would be provided on a priority basis for justified sites. Advance removal of dredged material from emergency placement sites will be accomplished as feasible. Differences between the CMP and existing State laws and other agency plans will require that the States and other agencies cooperate to allow implementation.</p> <p>Within funding constraints, the St. Paul District would provide the equipment capability and use the highest priority permitted placement sites. Although about one-half of the GREAT I designated placement sites may be usable under these constraints, some of the most important and priority sites cannot be reached under this program.</p>	<p>The St. Paul District would request the necessary funding and equipment capability to implement the GREAT I CMP as justified under Federal laws and regulations.</p>
		<p>Same as First Priority Program.</p>
<u>Action Item 2</u>		
The Corps of Engineers should follow the interim guidelines for dredged material placement developed by GREAT I.	<p>The guidelines would be followed to the extent practicable within capability and funding limits.</p>	<p>Same as Basic Program. Also refer to First Priority Program for Action Item 1.</p>
		<p>Same as First Priority Program.</p>

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I recommendation		Program		GREAT I
Basic		First Priority		
Action Item 3				
<p>The Corps of Engineers should continue restoring and establishing main stem shoreline protection on a yearly basis following the priority list prepared by GREAT I (Lovejoy, T.A. and D.M. Kennedy, 1979, attachment to the Fish and Wildlife Work Group Appendix) until completion. In place of funding and equipment capability on an as-available basis only to perform these tasks, the specific authority and funding should be provided to the Corps to stabilize a minimum of 5 miles annually.</p>	<p>The Corps has no ongoing program for bank protection. However, some bank protection work has been done intermittently. Potential savings in dredging costs are being evaluated at several locations. Bank protection could be accomplished as funding is available where the evaluations indicate economic effectiveness.</p>	<p>Bank protection would be provided at several high priority erosion areas. The sites would be monitored for reduction in dredging requirements and stability of protection works. Environmental effects would also be evaluated.</p>	<p>A total of 254 sites on the Mississippi River plus 21 sites on the Minnesota and St. Croix Rivers would receive shoreline protection at an average cost of \$200,000 per site or \$753,000 per mile. On this basis, an annual expenditure of \$3,765,000 would be required with a total program cost of about \$55,000,000 spread over about 15 years.</p>	
Action Item 4				
<p>Average annual dredging quantities should be minimized through application of technically supported reduced-depth dredging and maintenance of minimum channel widths suitable for navigation consistent with the following guidelines:</p> <p>a. Dredging depths in approaches to rigid structures should be determined by technically supported safety criteria.</p> <p>b. Dredging depths at other locations should be determined based on potential for increase in frequency of dredging, impacts on the transportation industry, and the demand for dredged material in the area.</p>	<p>Dredging would be accomplished using the safety criteria at approaches to rigid structures. At other locations, dredging depth would be determined on an individual site basis using the stated guidelines as well as any other pertinent factors.</p>	<p>Further refinement would be accomplished using the one-dimensional sediment transport model to predict potential dredging needs. Additional work would also be accomplished with the two-dimensional sediment transport model as feasible at selected locations. A literature search and analysis of the channel depth and width relationship as discussed would be accomplished. Modifications to dredging depths and widths to minimize dredging quantities would be planned wherever it could be supported by technical analysis, using the stated guidelines.</p>	<p>Same as First Priority Program.</p>	



Table A-1 - Program actions proposed and/or needed to implement recommendations (cont.)

GREAT I recommendation	Program		GREAT I
	Basic	First Priority	
<p><u>Action Item 5</u></p> <p>The Corps of Engineers should request the necessary appropriations to purchase efficient dredging equipment to best accomplish all the objectives of the GREAT I Channel Maintenance Plan. Until this equipment is available the Corps should emphasize contract dredging to meet these objectives.</p>	<p>As funding permits, the St. Paul District would use contract mechanical dredging for some locations where the existing Government-owned mechanical dredging unit is not available.</p>	<p>An equipment analysis will be made to determine the most desirable equipment mix and whether Government or contract equipment is most practical. However, on the basis of preliminary evaluations, the dredging fleet necessary to accomplish the CQP would probably include a large hydraulic dredge and two mechanical dredging units, one with mechanical unloading capability and the other with hydraulic unloading capability.</p>	<p>Same as First Priority Program.</p>
<p><u>Action Item 6</u></p> <p>In every case where in-floodplain placement of dredged material is proposed, a quantitative analysis of the effects of that placement must be made. This analysis must include a computation of the effect of any encroachment into the floodway by hydraulic encroachment on the other side of the river for a significant hydraulic reach. Variances to State standards requiring an equal degree of encroachment should be considered where the Federal Government owns the land on both sides of the river within the significant hydraulic reach. Until a quantitative analysis is conducted, the following guidelines will be used:</p>	<p>A mathematical model, HEC-2, is being developed for pools 4 and 5 to analyze the effects of dredged material placement on flood stages and for compliance with applicable State and local floodplain management regulations. The guidelines listed would be followed wherever possible as equipment and funding capability allow. Also, see Further Study Item 12.</p>	<p>Similar to the Basic Program, except that the funding necessary to complete the HEC-2 modeling for all pools in the District would be requested. Also, see Further Study Item 12.</p>	<p>Similar to First Priority Program, except that a compound streamflow model for floodplain management as discussed in Further Item 44 might be used instead of HEC-2 to estimate potential effects of dredged material placement.</p>

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I recommendation	Basic	First Priority	GREAT I
Action Item 6 (cont)			
a. Dredged material should be placed out of the floodplain of the Mississippi River and tributary streams.			
b. In those cases where in-floodplain placement is proposed, the material should be placed in the flood fringe rather than the floodway or effective flow area.			
c. Placement in the floodway or effective flow area may be conducted on a temporary basis and the material removed from the floodway before the seasonal high water in accordance with written agreements between the State or local floodplain regulatory agencies and affected landowners.			
Action Item 7			
Whenever reasonable, material dredged during channel maintenance should be placed at areas accessible for removal for beneficial purposes. Where known demand for dredged material exists, stockpile sites should be established to maximize the economic and social benefits made possible by having sand available for beneficial uses. A process should be developed and approved by an interagency committee to quickly identify and use new placement sites in order to satisfy new demands (either on a one-time or recurring basis) as they occur.	Historically, the District has attempted to make beneficial use of dredged material, within equipment capabilities. The District would continue these efforts as equipment and funding limitations allow. Beneficial use would be achieved where it is cost effective or justified by environmental considerations. Modification of the CMP would be proposed when new long-term beneficial use sites are justified.	Similar to Basic Program; however, additional studies and efforts would be made to identify and work with potential users of dredged material.	Compliance with GREAT I CMP which emphasizes beneficial use throughout.

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont.)

GREAT I recommendation		Program		GREAT I	
Basic		First Priority			
Action Item 8					
<p>Temporary material placement sites will be used when private or Government dredging capability to reach the GREAT I recommended CMP sites is not expected to be available before dredging is required. These sites should also be considered for use in emergency and imminent closure dredging situations as defined by GREAT I. In the selection and use of temporary sites, the following criteria shall apply:</p>		<p>As feasible, temporary placement sites would be used whenever equipment capability and funding would not allow use of the CMP sites. The availability of the CMP sites would be an important consideration.</p>		<p>Use of temporary material placement sites would comply with the guidelines; however, the availability of the CMP sites and the capability to implement the CMP are critical to fully implement this recommendation. Flexibility will be needed in the use of these temporary sites.</p>	
<p>a. Temporary sites approved by GREAT I are listed in the rationale.</p>				Same as First Priority Program	
<p>b. The annual notice will include a site plan for all temporary sites, showing material placement and removal plans and appearance of the site after its use.</p>					
<p>c. Material stockpiled at these sites will be removed by the following spring high water or as soon as possible under time and/or equipment limitations.</p>					
<p>d. Material removed will be taken to the channel maintenance plan approved sites.</p>					
<p>e. Temporary placement sites are not endorsed by GREAT I unless the material is excavated before any additional material placement. The additional amount placed is not to exceed the volume removed.</p>					

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I recommendation	Basic	First Priority	GREAT I
Action Item 9			
Criteria for sediment and water quality as they relate to dredging and material placement should be developed by the Environmental Protection Agency in consultation with the appropriate State and Federal agencies. Using these criteria, the States should develop uniform regulations for the control of dredging and dredged material placement. In the interim, the following guidelines should be used to determine proper methods for dredged material placement:	The Corps would continue to encourage the Environmental Protection Agency and regulatory agencies to develop sediment and water quality criteria and regulations for dredging and material placement. See Further Study Item 8.	For a trial period of 5 years, designated recreation areas would be posted when contaminated dredged material cannot be areas. adequately contained (emergency situations) and/or when contaminated materials are dredged. During this 5-year period, further study of the public health implications of the dredging and placement of contaminated sediments would be accomplished. If a health hazard, posting would be stopped.	Same as Basic and First Priority Programs without the 5-year limit on posting of recreation areas.
a. An adequate bottom sediment data base at frequently dredged locations should be developed and maintained.	The Corps would continue to use all available sources of information and data to determine if sediments to be dredged are contaminated.		
b. It should be determined if the material to be dredged is contaminated using 40 CFR 230, Interim Guidance for Section 404(b) of Public Law 92-500, Implementation Manual for Section 103 of Public Law 92-532, Environmental Protection Agency "Working Guidelines for Sediment Classification" (Great Lakes Criteria), and any other appropriate information in coordination with the affected States and agencies.	Contaminated materials would be contained in an environmentally safe area. Effluents from diked placement areas would be monitored. Open-water placement would be monitored. Bioassays would be done to determine dredged material toxicity.		
c. Contaminated dredged material shall be placed in an environmentally safe containment area.			
d. Uncontaminated material shall be placed in accordance with the GREAT I CRR. If the CRR site cannot be used, an alternative site shall be selected in coordination with the affected States and agencies including using the On-Site Inspection Team Process. Open-water placement or beach nourishment may be considered as an alternative.			

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I Recommendations	Basic	First Priority	GREAT I
Action Item 9 (cont)			
<p>e. Water quality during dredging and placement should be monitored whenever dredged material or supernatant is returned to the water. Treated effluents shall be monitored for total suspended solids, turbidity, and other appropriate parameters of concern. Open-water placement shall be monitored w/phasizing the use of indicator parameters, water quality standard parameters, and toxic substance scans. Water quality and sediment monitoring programs should be coordinated among affected States and agencies.</p>			
f. Where contaminated material cannot be adequately contained, appropriate warnings to recreationists shall be posted for a distance of 2 miles downstream of the placement sites. When contaminated materials are dredged, designated recreation areas within 1,000 feet downstream of the dredging operation should be posted.			
Action Item 10			
<p>The Corps of Engineers should prepare and implement, after appropriate interagency evaluation, site development plans for all historic and proposed dredged material placement sites. The following guidelines should be used for preparation of the plans:</p> <ol style="list-style-type: none"> <li>1. Use landscape architecture skills.</li> <li>2. Prepare plans before on-site inspection team meetings.</li> <li>3. Identify proposed uses and management.</li> <li>4. Consider equipment availability and mobilization.</li> <li>5. Consider needs for revegetation.</li> <li>6. Consider needs for erosion control.</li> </ol>	<p>The development of site plans would be initiated at several historic and proposed placement sites as funding allows. A list of sites for implementation is being developed and coordinated with appropriate State and Federal agencies. Site plans for temporary and permanent CMP sites would receive priority.</p>	<p>Site Development plans would be prepared for proposed placement sites and many of the more important historic sites would be prepared at all historic sites.</p>	<p>Same as First Priority Program, except plans would be prepared at all historic sites.</p>

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

Action Item	Program	
	Basic	First Priority
<b>Section I Recommendations</b>		
<b>Section I Recommendation</b>		
<b>Action Item 11</b>		
Bank stabilization and establishment of sediment traps on low-head dams near the mouth have been identified as potential alternatives for sediment control on the Mississippi River and should be further evaluated and implemented as soon as possible.	Evaluation of sediment control on the Mississippi River to reduce dredging requirements in lower pool 4 would be continued. Alternatives other than bank stabilization and sediment traps above the Burlington Northern bridge would also be considered. A pilot dredging of a sediment trap at the Delta of the Mississippi River would be tied to the CWP for lower pool 4.	Alternatives and the pilot effort would be evaluated to determine a recommended permanent solution. Further coordination would be accomplished before implementation.
		Same as First Priority Program.
<b>Action Item 12</b>		
Application of soil erosion control practices and/or best management practices for nonpoint sources should be increased in the critical sediment source area of the Mississippi River to the extent possible, through the use of programs administered by the U.S. Department of Agriculture (Soil Conservation Service and Agricultural Stabilization and Conservation Service) and similar State programs. Congress continues support of ongoing programs. The Rural Clean Water Program should be extended and funded to the level previously authorized (\$400,000,000 per year).	The St. Paul District endorses Department of Agriculture and State efforts to implement this program because they would improve the quality of the river and potentially reduce some of the management problems associated with the operation and maintenance of the 9-foot channel.	Same as Basic Program.
<b>Action Item 13</b>		
The Environmental Protection Agency should maintain a list of all substances that would significantly threaten the riverine environment if a spill occurred. The U.S. Coast Guard should continue to develop and enforce regulations on the shipment of hazardous materials including prohibitions, where necessary.	The Corps of Engineers would cooperate with the Environmental Protection Agency and the U.S. Coast Guard to monitor the locations of hazardous materials as they are shipped through the locks.	Same as Basic Program.

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I Recommendation		Basic Program		GREAT I	
		First Priority			
<u>Action Item 14</u> Sanitary pump-outs and trash pickup points should be established in suitable areas.	None would be established. Sanitary pump-outs and trash pickup facilities if located at the locks and dams would delay lockages and cause traffic congestion. For recreation craft, owners of boat launching facilities and operators of marinas and service facilities for small craft should provide such facilities. Commercial craft have adequate facilities to contain wastes until they reach their loading or unloading destination where such facilities should be located at the expense of commercial interests.	Portable trash containers would be placed at lockage waiting areas above and below each of the several locks. Regular emptying service and removal before floods would be provided. During a trial period of 2 to 3 years, the effectiveness of this trash collection program would be evaluated.  No provisions would be made for commercial towboats because they can use facilities at terminals. No sanitary pump-outs would be provided.  (Cost - \$12,000 per year)	Trash containers and pump-out facilities would be provided at two locations per pool. Extensive work would have to be done to provide for the sanitary pump-out facilities.  (First cost - \$2,000,000; annual O&M - \$170,000)		
<u>Action Item 15</u> Both State and Federal agency that contributes to the national resource management of the Upper Mississippi River should place more emphasis on the river by increasing staff and budget allocations to the work on the fish and wildlife resources of the river.	Current level of staff working on environmental matters on the river (which is approximately 6 man-years of effort not including regulatory functions) should be maintained. Staffing levels might be reevaluated to ensure compliance with national policy.	Staff and funding would be increased (consistent with the national policy on staffing) to handle the additional work load of first priority items.	Staff and funding would be increased to handle the work load from full implementation of GREAT I Program.		
<u>Action Item 16</u> Gated culverts should be placed at the dikes of lock and dam 4.	The St. Paul District intends to coordinate with Federal and State agencies to develop acceptable plans for implementation.	Same as Basic Program.	This design would be completed and implemented.  (Cost - about \$500,000)		
<u>Action Item 17</u> A gated culvert should be constructed through the dike of lock and dam 10 to provide a water supply to the waterfowl in pool 11.	The St. Paul District intends to coordinate with Federal and State agencies to develop acceptable plans for implementation.	Same as Basic Program.	The design would be completed and implemented.  (Cost - about \$300,000)		

Table A-1 - Program actions proposed and/or needed to implement recommendations

GREAT I recommendation	Basic	Program	GREAT I
	First Priority	First Priority	First Priority
Action Item 18	No action planned.	Same as Basic Program.	Same as Basic Program.
<p>The U.S. Fish and Wildlife Service should continue to upgrade and expand facilities of the Upper Mississippi River Wild Life and Fish Refuge under the Bicentennial Land Heritage Program and other potential funding sources.</p>	<p>The update to the recreation and resource management plan would review the current and projected levels of public use of dredged material areas. Sites recommended by GREAT and those included in the CMP would be considered first. A generalized conceptual development plan for the shaping and vegetation of sites would be included. Cost estimates would be prepared for moving material to sites receiving high priority status for material placement.</p>	<p>Recreation enhancement will be included in the assessment of dredged material sites through implementation of the CMP and in review of emergency placement sites. Site specific development plans will be prepared on an annual basis for sites receiving material.</p>	<p>Recreation enhancement plans will be prepared for all historically used recreation sites as well as new sites incorporated into the CMP. The possibility of borrowing material from heavily used sites to provide needed material for sites located in low maintenance areas will be included.</p>
Action Item 19	<p>Primitive recreational use sites should be maintained on an interim basis until implementation of comprehensive management plans.</p>	<p>Recreation enhancement will be included in the assessment of dredged material sites through implementation of the CMP and in review of emergency placement sites. Site specific development plans will be prepared on an annual basis for sites receiving material.</p>	<p>Recreation enhancement plans will be prepared for all historically used recreation sites as well as new sites incorporated into the CMP. The possibility of borrowing material from heavily used sites to provide needed material for sites located in low maintenance areas will be included.</p>
Action Item 20	<p>"Lockage waiting areas" should be developed where suitable to reduce hazards associated with recreational lockages.</p>	<p>The update to the recreation and resource management plan would review current planning efforts on the placement of lockage waiting areas. This review would include an overview of the impacts of lockage waiting areas and associated O&amp;M activities. (No cost)</p>	<p>Same as First Priority Program.</p>



Table A-1 - Program actions proposed and/or needed to implement recommendations (cont.)

GREAT Lakes Program	Basic	First Priority	GREAT Lakes
<u>Action Item 21</u>	Detailed uniform recreational facility guides in a format which includes information unique to the Mississippi River (boating hazards, special regulations, refuge management, locking procedures, etc.) should be provided.	The update to the Corps' recreation and resource management plan would include an update to the GREAT recreation resource inventory. The revised data would be made available to outside agencies who provide brochures to the public. The Corps would continue to distribute to the public pamphlets on boat safety and locking procedures.	The District will provide leadership in the preparation (planning, drafting, reproduction, and distribution) of recreation facility guides.
<u>Action Item 22</u>	Uniform and/or approved signage of recreation areas should be provided.	The update to the District's recreation and resource management plan would include an assessment of the need for signs on federally owned, Corps-managed lands. This material would be summarized in an appendix of the resource management plan. Recommended sign plans would be considered for implementation over the next 5-10 years as required O&M funds are made available.	An accelerated planning effort would be undertaken to determine the need for uniform upgrading of signs on Federal lands. This effort would include close coordination with the Fish and Wildlife Service. Implementation of recommended sign plans would be initiated as soon as funds were made available.
<u>Action Item 23</u>	Control structures should be removed or modified where appropriate to reduce hazards to recreational navigation.	No program of marking wing dams or closing dams would be undertaken. Navigation charts which give approximate locations of these hazards would continue to be provided.	An inventory of wing dams and closing dams (see Further Study Item 5) would be compiled. An evaluation would be conducted to determine the relative hazard of these structures. Several (about 10) of the most hazardous areas would be marked for a 3-year trial period.
<u>Action Item 24</u>	States should adopt and enforce uniform noise levels for recreation boats and other vehicles.	No action planned.	Same as Basic Program.

**Table 4-1 - Program actions proposed and/or needed to implement recommendations (cont.)**

Action Item	Priority	Status	Comments
Action Item 25	First Priority <td>Same as Basic Program.</td> <td> <p>A survey should be provided in conjunction with the Great River and development.</p> <p>Emphasis on planning and implementation would include the development of higher cost support facilities (for example, sanitary facilities; access roads with parking, signing, lighting, and canoe launch); primitive camp sites). Coordination with the Fish and Wildlife Service would be required.</p> </td>	Same as Basic Program.	<p>A survey should be provided in conjunction with the Great River and development.</p> <p>Emphasis on planning and implementation would include the development of higher cost support facilities (for example, sanitary facilities; access roads with parking, signing, lighting, and canoe launch); primitive camp sites). Coordination with the Fish and Wildlife Service would be required.</p>
Action Item 26	First Priority <td>Same as Basic Program.</td> <td> <p>No action planned.</p> <p>Planning efforts would be accelerated to provide a full review of canoe trail needs and related site suitability within 2 years. Emphasis would again be placed on development of interpretive activities which could be incorporated with trail layout and management. Coordination with the Fish and Wildlife Service would be required.</p> </td>	Same as Basic Program.	<p>No action planned.</p> <p>Planning efforts would be accelerated to provide a full review of canoe trail needs and related site suitability within 2 years. Emphasis would again be placed on development of interpretive activities which could be incorporated with trail layout and management. Coordination with the Fish and Wildlife Service would be required.</p>
Action Item 27	First Priority <td>Same as Basic Program.</td> <td> <p>The updates to the District's recreation and resource management plan would review the need for and suitability of canoe trails within the Upper Mississippi River corridor. Initial focus would be the development of trail signs and markers, low-cost support facilities. Emphasis would be on preparation of public information pamphlets for trail interpretation of natural and cultural features. Extensive coordination with the Fish and Wildlife Service would be required.</p> <p>This action is being studied under the Section 187 program of the Corps of Engineers. If it is economically feasible and requirements of local cooperation are met, the channel will be improved.</p> </td>	Same as Basic Program.	<p>The updates to the District's recreation and resource management plan would review the need for and suitability of canoe trails within the Upper Mississippi River corridor. Initial focus would be the development of trail signs and markers, low-cost support facilities. Emphasis would be on preparation of public information pamphlets for trail interpretation of natural and cultural features. Extensive coordination with the Fish and Wildlife Service would be required.</p> <p>This action is being studied under the Section 187 program of the Corps of Engineers. If it is economically feasible and requirements of local cooperation are met, the channel will be improved.</p>
Action Item 28	First Priority <td>Same as Basic Program.</td> <td> <p>The St. Paul District would continue to distribute information brochures plus presentations to interested parties. This effort would be expanded as the demand for these services increases.</p> </td>	Same as Basic Program.	<p>The St. Paul District would continue to distribute information brochures plus presentations to interested parties. This effort would be expanded as the demand for these services increases.</p>

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont.)

GREAT I recommendation	Basic	Program	
		First Priority	GREAT I
<u>Action Item 29</u>			
The U.S. Coast Guard Auxiliary, boating clubs, and others concerned with boater education, should intensify their education efforts on safety, navigation, and hazards peculiar to vessel operation on the Upper Mississippi River.	In a similar manner as in Action Item 28, the St. Paul District would continue efforts in this area and increase them as demand increases. Cooperation with other agencies would be maintained to assist others in their efforts in this area.	Same as Basic Program.	Same as Basic Program.
<u>Action Item 30</u>			
Local agencies should be required to better brief their patrons on how to handle their boats, river hazards, rules of the road, courtesy, and lockage procedures.	No action planned.	Same as Basic Program.	Same as Basic Program.
<u>Action Item 31</u>			
Additional water patrol personnel should be assigned to the Mississippi River, especially in heavily used areas and high accident areas. Coordination of enforcement programs should continue.	The Corps would continue to cooperate with water patrol enforcement personnel.	Same as Basic Program.	Same as Basic Program.
<u>Action Item 32</u>			
The "packing out" of trash should be encouraged through educational pamphlets, programs, and signing.	Existing brochures and guidance pamphlets for small craft operators on the river would be revised to include a section on maintaining clean land and waters for greater public enjoyment. No specific cost.	Same as Basic Program.	Same as Basic Program.
<u>Action Item 33</u>			
Detailed topographic and hydrographic maps of the Upper Mississippi River bottomlands in the GREAT I area (at a scale no smaller than 1:12,000; or 1 inch equals 1,000 feet; on an orthographic base with a contour interval of 2 feet) should be produced.	Photography and data in Corps files would be available for mapping use if needed.	Same as Basic Program.	Same as Basic Program.

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I recommendations			GREAT I	
Basic			First Priority	
Action Item 34			Same as Basic Program.	Same as Basic Program.
<p>Favor resource projects on tributaries of the Upper Mississippi River in the GREAT I area should address:</p> <p>a. Project-induced potential changes in tributary discharges during floods.</p> <p>b. Project-induced potential changes in the bed load sediment transport capability of the tributary streams.</p>				
<p>Any proposed Corps projects on tributaries would address the potential changes in discharges and bed load sediment transport capability on these tributaries where the effects are capable of being measured or estimated.</p>				
Action Item 35			Same as Basic Program.	Same as Basic Program.
<p>The Upper Mississippi River Basin Commission should encourage and coordinate efforts to develop information and education programs for the Upper Mississippi River. Such programs should focus on the multiple uses and values of the resource.</p>				
<p>The Corps would cooperate with the Basin Commission in this endeavor.</p>				
Action Item 36			Similar to Basic Program, except that the inter-agency management coordination team would be considered for formalization during the next critical stages of implementation. The forum consists of representatives of State and Federal agencies with principal responsibilities on river management. The forum members fund their own participation. Most of the actions of the forum relate to channel maintenance and implementation of the CMP. The Corps and the Wisconsin Department of Natural Resources are serving as co-chairs. No formal agreements are being used.	Same as First Priority Program.
<p>The agencies represented in GREAT I, by letter of agreement, should continue to coordinate implementation of the channel maintenance plan and all other implementable recommendations through the continuation of an ongoing interagency management coordination team. The U.S. Fish and Wildlife Service and the Corps of Engineers would be the initial co-chairs. Chairmanship would then be rotated among participating agencies. Participation in this activity will be staffed and funded by individual agency contributions. Agencies will request additional appropriations within existing programs where necessary to accomplish this effort.</p>				

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

Table A-1 - Program actions proposed and/or needed to implement recommendations	Program	First Priority	GREAT I
GREAT I recommendation	Basic	First Priority	Same as Basic Program.
Action Item 37			
As part of the above activity/organization the following coordination mechanisms should be used:	See Action Item 36. As a part of the "Channel Maintenance Coordination Forum," engineering and environmental task forces would be formed to serve in a similar fashion to the on-site inspection team and channel dimensions review committee, as well as perform other functions including proposing changes to plans or recommendations, establish priority lists for specific recommendations and actions, etc. The On-Site Inspection Team process would continue.		
a. The Interagency On-Site Inspection Team recommended by GREAT I should be continued to provide consultation in the site-specific implementation of the GAP and to aid in resolution of new problems which may develop during the annual dredging seasons. Exhibit I shows guidelines for continuation of the on-site inspection team.			
b. A channel dimensions review committee should be established, consisting of representatives of the Corps of Engineers, U.S. Coast Guard, and navigation industry, and representatives from other concerned State and Federal agencies that have expertise in hydraulics or vessel navigation requirements. The task of the committee will be to review industry needs for channel widths and advise the Corps of Engineers in establishing acceptable channel widths and thus guiding dredging operations at affected sites.			
c. The existing independent Upper Mississippi River Conservation Committee is encouraged to participate in the ongoing inter-agency management coordination team. It is suggested they evaluate their role in this effort and participate in a manner they feel appropriate. Finally, GREAT I recognizes that the Minnesota-Wisconsin Boundary Area Commission has played a significant role in the establishment and implementation of the GREAT I study. As a staffed citizen body appointed and funded by the States of Minnesota and Wisconsin, concerned about the overall management of the border rivers (St. Croix and Upper Mississippi), is it appropriate that it continue to monitor the implementation of GREAT I recommendations.			

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I recommendation	Program		GREAT I
	Basic	First Priority	
<p>Action Item 38</p> <p>Monitoring of GREAT I implementation from an independent citizen perspective should be continued by the Minnesota-Wisconsin Boundary Area Commission. The States of Minnesota and Wisconsin should fund this effort as a work item of the MNBAC.</p>	<p>The Corps would cooperate with the Commission in its monitoring efforts.</p>	<p>Same as Basic Program</p>	<p>Same as Basic Program.</p>
<p>Action Item 39</p> <p>The Upper Mississippi River Basin Commission through its Great River Study Committee should develop a total river resource management plan. As resources for this plan, the Upper Mississippi River Basin Commission should use the products of GREAT's I, II, and III and the master plan reports as well as other relevant data.</p>	<p>The Corps would provide information that has been collected through GREAT I and other studies to the Basin Commission as needed.</p>	<p>Same as Basic Program.</p>	<p>Same as Basic Program.</p>
<p>Policy/Funding Item 1</p> <p>Congress should continue to authorize the maintenance of the navigation channel to meet current and future needs of commercial navigation consistent with other resource requirements.</p>	<p>The Corps would continue to testify to Congress for funds to operate and maintain the 9-foot channel consistent with the authorities that Congress has given and/or will give to the Corps.</p>	<p>Same as Basic Program, except that items under the First Priority Program would be included in budget submissions.</p>	<p>Same as Basic Program.</p>
<p>Policy/Funding Item 2</p> <p>The necessary funding and personnel should be provided to the Corps of Engineers for preparation of long-term plans to implement the GREAT I channel maintenance plan. These long-term plans should include scheduling of necessary interagency coordination, permit applications, and land acquisitions. Additional specific coordination activities should be initiated when it becomes apparent that dredging will be required during the dredging season.</p>	<p>The Corps would develop a specific program to implement the CMP as funding and personnel limits allow. Also see Action Item 1.</p>	<p>Preparation of a specific program to implement the long-term CMP and other recommendations will require additional funding and personnel. The necessary funding and personnel would be requested. Also see Action Item 1.</p>	<p>Same as First Priority Program.</p>

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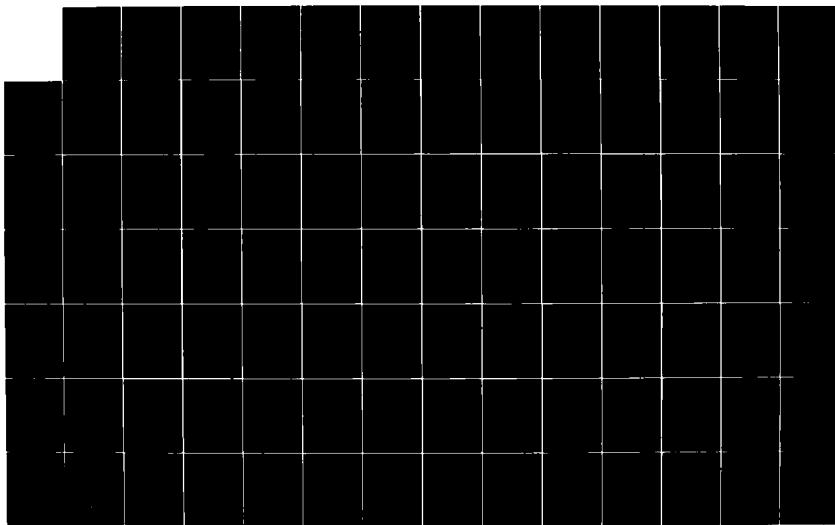
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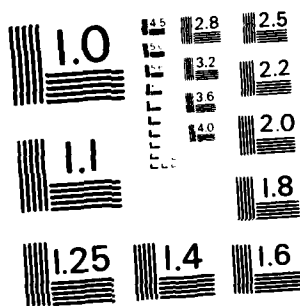
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Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I recommendation		Basic	First Priority	GREAT I
Action Item 38				
Monitoring of GREAT I implementation from an independent citizen perspective should be continued by the Minnesota-Wisconsin Boundary Area Commission. The States of Minnesota and Wisconsin should fund this effort as a work item of the MBAC.		The Corps would cooperate with the Commission in its monitoring efforts.	Same as Basic Program	Same as Basic Program.
Action Item 39				
The Upper Mississippi River Basin Commission through its Great River Study Committee should develop a total river resource management plan. As resources for this plan, the Upper Mississippi River Basin Commission should use the products of GREAT's I, II, and III and the master plan reports as well as other relevant data.		The Corps would provide information that has been collected through GREAT I and other studies to the Basin Commission as needed.	Same as Basic Program.	Same as Basic Program.
Policy/Funding Item 1				
Congress should continue to authorize the maintenance of the navigation channel to meet current and future needs of commercial navigation consistent with other resource requirements.		The Corps would continue to testify to Congress for funds to operate and maintain the 9-foot channel consistent with the authorities that Congress has given and/or will give to the Corps.	Same as Basic Program, except that items under the First Priority Program would be included in budget submissions.	Same as Basic Program.
Policy/Funding Item 2				
The necessary funding and personnel should be provided to the Corps of Engineers for preparation of long-term plans to implement the GREAT I channel maintenance plan. These long-term plans should include scheduling of necessary interagency coordination, permit applications, and land acquisitions. Additional specific coordination activities should be initiated when it becomes apparent that dredging will be required during the dredging season.		The Corps would develop a specific program to implement the CMP as funding and personnel limits allow. Also see Action Item 1.	Preparation of a specific program to implement the long-term CMP and other recommendations will require additional funding and personnel. The necessary funding and personnel would be requested. Also see Action Item 1.	Same as First Priority Program.

Table A-1 - Program actions proposed and/or needed to implement recommendations

GREAT I recommendation		Program	GREAT I
Policy/Funding Item 3		First Priority	
<p><u>Emergency dredging</u> should be defined as dredging required to free a grounded vessel or remove shoals in the channel as a result of a vessel freeing itself. The emergency will continue only until an adequate channel depth and width, as determined by the Corps of Engineers, is restored to allow vessel passage.</p> <p><u>Imminent closure</u> should be defined as:</p> <p>a. The actual water depth is projected by the District Engineer to be 10 feet or less within 14 days or less or</p> <p>b. The channel width is less than 85 percent of the normally maintained width.</p>		Same as Basic Program.	Same as Basic Program.
<p>Formal agreements concerning emergency dredging and imminent closure as defined by GREAT I are being sought for the 1981 dredging season from appropriate agencies with regulatory responsibilities. Minor modification to this definition may be required to accommodate the concerns of the States, recognizing that the GREAT II definition is slightly different.</p>			
Policy/Funding Item 4			
<p>The Corps of Engineers should maintain sufficient dredging capability in the St. Paul District to perform emergency and national defense dredging.</p>		The Thompson or a comparable dredge is tentatively planned for future use in implementing portions of the CMP. This dredge would not have to be maintained in the St. Paul District but should be readily available on a regular and emergency basis from nearby Districts.	Same as First Priority Program.
Policy/Funding Item 5			
<p>The Corps of Engineers should attempt to sell dredged material to sand and gravel companies.</p>		<p>The St. Paul District intends to maintain the Dredge Thompson for use in the District to handle large volume emergency or national defense dredging where either mechanical, other hydraulic, or contractor plant would not meet the needs considering limitations of availability, cost, and productivity. The Thompson is also planned for future use on those sites in the CMP where it can be used. Also see Action Item 5. The Chief of Engineers would determine a minimum dredging fleet which may modify this position regarding the Thompson.</p> <p>Sand and gravel companies would be formally notified of the projected availability of dredged materials. Material would continue to be offered free of charge to anyone who would come and take it.</p>	<p>Efforts would be initiated to sell dredged material in compliance with the CMP.</p> <p>See Action Item 7.</p>

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I recommendation		Basic Program	First Priority	GREAT I
<u>Policy/Pending Item 6</u>				
The Corps of Engineers should change its policy and allow acquisition of private lands for stockpiling of dredged material to implement the CMP and make material available for beneficial use.		The St. Paul District would recommend approval to purchase easements or fee title for specific placement sites as funding permits. Suitable easements would be preferred over fee title acquisition.	The District would request approval on a site-specific basis to acquire easements or fee title purchase of necessary privately owned placement sites to allow implementation of the CMP. Additional funds to acquire these sites would be requested so that these sites could be purchased at the earliest possible date to ensure that the site is available when dredging is necessary.	Same as First Priority Program.
<u>Policy/Pending Item 7</u>				
State and Federal agencies should seek modification of their laws and requirements to allow creation and maintenance of interagency recommended recreation and fish and wildlife enhancement within the floodplain and implementation of the CMP.		The Corps would:	In addition to the Basic Program, the Corps would support other needed modifications as identified on a case-by-case basis.	In addition to the First Priority Program, the Corps would undertake any other actions to allow full implementation of GREAT I recommendations and the CMP.
		1) Continue to work with the States of Iowa, Minnesota, and Wisconsin and the Environmental Protection Agency to develop reasonable effluent standards for contained placement areas.		
		2) Support changes in Section 30.12 of Wisconsin Statutes to allow for the placement of dredged material below the ordinary high-water mark on a permit basis.		
		3) Attempt to reach mutual agreement with the States on appropriate methods to evaluate the impacts of dredged material on the floodplain.		
<u>Policy/Pending Item 8</u>				
Congress should define the Mississippi River 9-foot Navigation Project as that necessary to afford safe navigation for vessels with a draft no greater than 9 feet.		No action planned. The 9-foot channel is sufficiently well defined through the existing congressional authorization for the project and other congressional authorities provided to the Chief of Engineers. The project as operated and maintained is in accordance with the spirit and the letter of the authorities provided to the Corps. The GREAT I recommended definition would not change current or anticipated maintenance practices.	Same as Basic Program.	Congressional action would be required to change the definition; however, no significant changes in the operation and maintenance of the 9-foot channel are anticipated as a result of this definition change.

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont.)

GREAT I recommendations		Basic		First Priority		Program	
Policy/Funding Item 9	<p>The Fish and Wildlife Service in coordination with the States and the Corps of Engineers should develop and implement a comprehensive plan for the management of the Upper Mississippi River Wildlife and Fish Refuge that considers all the fish and wildlife resources of the area and consists of the necessary strategic and operational components to make explicit the background, authorities, and justification for the refuge and objectives, policies, coordination measures, and procedures by which it will be operated.</p>	<p>Input to the refuge master plan would be provided "as requested." Review and comments on the refuge master plan would be provided. Corps programs would be coordinated with the refuge master plan to minimize conflicts. A Memorandum of Understanding would be developed with the Fish and Wildlife Service to coordinate refuge master planning efforts with the Corps recreation master planning efforts to the extent possible under current policy constraints.</p>	<p>The Corps has no specific plans along these lines. Coordination of our work on the river would be continued with the Fish and Wildlife Service and the States.</p>	<p>The lead effort to develop these management plans is with the Fish and Wildlife Service and the States. Corps plans and programs would be coordinated and integrated with their efforts to ensure compatibility as much as possible. Additional costs would be required for this extra study and coordination effort.</p>	Same as Basic Program	Same as Basic Program.	
Policy/Funding Item 10	<p>State and Federal natural resource agencies should develop their management plans cooperatively and implement their management programs so that the Upper Mississippi River is managed as an ecological unit.</p>	<p>Under existing authorities, the Corps of Engineers can assist the Fish and Wildlife Service and the States in accomplishing projects for fish and wildlife conservation and recreation when these agencies would provide part or all of the funding. Current Federal water policies can provide 50 percent Federal funding for fish and wildlife enhancement actions and for recreation actions related to the 9-foot channel project. A non-Federal sponsor must contribute the remaining share of the costs. The Corps would continue working under these authorities and policies. If the States indicate any interest, the St. Paul District would further pursue coordination with the appropriate Federal and State agencies on evaluation of the merits of adding fish and wildlife and recreation as full project purposes to the 9-foot channel project.</p>	<p>The Corps would continue under authorities and policies similar to the Basic Program. This authority and policy could be pursued through the Army civil works legislative program; however, this action is not planned at this time. In those areas where Corps construction and design capability would be instrumental to implementation of the project, but funding through the Corps process is difficult, the Corps would cooperate to the fullest extent if the funding were available through the Fish and Wildlife Service or the States.</p>	<p>If Congress were to change the cost-sharing requirements for recreation and fish and wildlife enhancement projects for the 9-foot channel project in the GREAT I area or the entire Upper Mississippi River area, the Corps would request funds to implement those features that are justifiable and included in the GREAT I recommendations and/or the recreation and resource management plan.</p>	Same as Basic Program	Same as Basic Program.	
Policy/Funding Item 11	<p>Congress should provide the Corps of Engineers with definitive authority and funding to assist the Fish and Wildlife Service and the States in accomplishing fish and wildlife conservation and recreation projects on the Upper Mississippi River.</p>	<p>Under existing authorities, the Corps of Engineers can assist the Fish and Wildlife Service and the States in accomplishing projects for fish and wildlife conservation and recreation when these agencies would provide part or all of the funding. Current Federal water policies can provide 50 percent Federal funding for fish and wildlife enhancement actions and for recreation actions related to the 9-foot channel project. A non-Federal sponsor must contribute the remaining share of the costs. The Corps would continue working under these authorities and policies. If the States indicate any interest, the St. Paul District would further pursue coordination with the appropriate Federal and State agencies on evaluation of the merits of adding fish and wildlife and recreation as full project purposes to the 9-foot channel project.</p>	<p>The Corps would continue under authorities and policies similar to the Basic Program. This authority and policy could be pursued through the Army civil works legislative program; however, this action is not planned at this time. In those areas where Corps construction and design capability would be instrumental to implementation of the project, but funding through the Corps process is difficult, the Corps would cooperate to the fullest extent if the funding were available through the Fish and Wildlife Service or the States.</p>	<p>If Congress were to change the cost-sharing requirements for recreation and fish and wildlife enhancement projects for the 9-foot channel project in the GREAT I area or the entire Upper Mississippi River area, the Corps would request funds to implement those features that are justifiable and included in the GREAT I recommendations and/or the recreation and resource management plan.</p>	Same as Basic Program	Same as Basic Program.	

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I recommendation	Basic	First Priority	GREAT I
<p><u>Policy/Funding Item 12</u></p> <p>Future Mississippi River management budgets should show, as separate line items, those programs that request funds to benefit recreation or fish and wildlife and are not required to maintain the 9-foot navigation project.</p>	<p>The zero-based budgeting data show, as separate line items, all proposed work. The approved program presented to Congress does not show separate line items for work not directly required to operate and maintain the 9-foot channel. Costs for some improvements, such as small-craft harbors are justified and displayed separately. Cost data are maintained in the District by each separate study and action and could be used to support separate line item requests. No change from current practices is anticipated.</p>	<p>Separation of costs by line items for those actions which are required for the benefit of recreation, fish and wildlife, and commercial navigation would be presented to the Chief of Engineers and would be available for submission to Congress if desired. These data could be used in conjunction with cost allocations and authority for other purposes. (See Policy/Funding Items 11 and 13.)</p>	<p>Same as First Priority Program except that these separations would be reported to Congress. Action by the Chief of Engineers would be required.</p>
<p><u>Policy/Funding Item 13</u></p> <p>Beneficiary/user data should be developed and used by appropriate agencies in managing water resources and developing cost allocation programs.</p>	<p>Information gathering is directed by Public Law 95-302 to assess the relative costs of the various purposes served by the waterway projects. Two methods of cost allocation have been analyzed for the GREAT I area: a modified use of facilities method and a separable costs-remaining benefits method. The Chief of Engineers office is coordinating the results of this analysis with results from other Districts. Benefits have not been developed in this analysis, rather the use of facilities and cost-separation have been emphasized. This information may be used by the Chief of Engineers to recommend a cost allocation system.</p>	<p>Additional information on beneficial use would be gathered and a cost allocation system developed for the GREAT I reach of the river system.</p>	<p>Same as First Priority Program.</p>
<p><u>Policy/Funding Item 14</u></p> <p>Unified management objectives (recreation, fish and wildlife, commercial, etc.) should be developed for each pool or segment of pools. The development of unified management objectives must be consistent with legislative mandates for management of National Wildlife Refuges.</p>	<p>Operation would continue under existing management programs and plans.</p>	<p>Requires lead effort by the Upper Mississippi River Basin Commission. Corps would participate in the development of unified management objectives with appropriate State and Federal agencies.</p>	<p>Same as First Priority Program.</p>

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT RIVER Recommendation	Basic		First Priority	GREAT R
	Policy/Funding Item 15	Policy/Funding Item 16		
Organisms not native to the Upper Mississippi River corridor should be cooperatively analyzed to determine compatibility with the integrity of the native communities before they are introduced.	No action planned.	Same as Basic Program.	Same as Basic Program.	Same as Basic Program.
Policy/Funding Item 16 Scenic easements/acquisitions should receive a higher priority in conjunction with the implementation of the Great River Road and other applicable State and Federal programs.	The relationship of any scenic easement program with the Great River Road and Corps-owned land would be addressed in the recreation and resource management plan.	Same as Basic Program.	Same as Basic Program.	Same as Basic Program.
Policy/Funding Item 17 So that operating regulations for fixed and opening bridges can be vigorously enforced by the U.S. Coast Guard, the Act of August 1864, Act of March 3, 1899, Bridge Act of 1906, and the General Bridge Act of 1946 should be amended to provide for civil penalties in certain circumstances and for other purposes as recommended by the U.S. Coast Guard.	No action planned.	Same as Basic Program.	Same as Basic Program.	Same as Basic Program.
Policy/Funding Item 18 Obstructive bridges should be rebuilt to provide adequate horizontal and vertical clearances. The Truss-Hobbs Act should: a. Continue to be used in rebuilding bridges on the basis of navigation needs. b. Be amended to include replacement or repair of bridge protection systems. c. Be amended to include benefits to land as well as marine interests. Because public money is being spent, the total public benefit should be considered in benefit-cost ratios.	No action planned.	Same as Basic Program.	Same as Basic Program.	Same as Basic Program.

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I recommendations		Program		GREAT I	
Basic		First Priority		GREAT I	
<p><u>Policy/Funding Item 19</u></p> <p>Boathouse permits should be carefully controlled and enforced to prevent extended residency, sanitary discharge, and aesthetic impacts.</p>		<p>Corps policy on granting of special use licenses prohibits the residential use of boat-houses. Efforts are under way to further enforce this policy.</p> <p>A moratorium has been initiated on granting of special use licenses. In coordination with the Fish and Wildlife Service and the States, land use allocations and development recommendations within the master plan would be used to evaluate the appropriateness of granting licenses for boat garages in the future.</p>		<p>Same as Basic Program.</p> <p>Same as Basic Program.</p>	
<p><u>Policy/Funding Item 20</u></p> <p>The Corps of Engineers should monitor lockages to ensure the proper application of existing lockage regulations and to identify specific problem areas. If problems are identified, consideration should be given to providing signage, low power radio transmissions (AM, CB, and/or Marine) near the locks to dispense information, and/or lockage waiting areas. Information on designated times should be widely publicized.</p>		<p>Periodic monitoring of the application of existing lockage regulations would be accomplished to identify problem areas. Proper application of lockage regulations would be provided.</p>		<p>Public information programs and/or other information disseminating methods will be provided to supplement existing programs where analysis or expressed public concern shows a need.</p>	
<p><u>Policy/Funding Item 21</u></p> <p>High impact recreational development such as large powerboat accesses or marinas should be discouraged in or adjacent to areas identified as exceptionally good for hunting, trapping, and fishing or "closed refuge areas."</p>		<p>The update to the Corps recreation and resource management plan would address the issue of protecting and enhancing fish and wildlife areas. Appropriate resource use objectives and related land use zoning would provide guidance toward effective management actions.</p> <p>The effects of high impact recreation developments would be addressed before site-specific recommendations for development are made.</p>		<p>Same as Basic Program.</p> <p>Same as Basic Program.</p>	

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I Recommendation		Basic	First Priority	GREAT I
Policy/Funding Item 22	River management agencies should increase their efforts to work together cooperatively in undertaking site-specific intensive recreation surveys and continuous annual sample data collection for input into a recreation resource monitoring program. Methods developed by the GREAT I and GREAT II Recreation Work Groups should be used in these efforts.	The Corps has limited manpower available to assist in conducting recreation surveys on the Upper Mississippi River from the field manager's office. The update to the District's recreation and resource management plan would address the need for and identity of an experimental annual recreation resource monitoring program. PMS data would be revised on the basis of annual samples.	The Corps would accelerate the planning schedule of the Basic program. Activities would be expanded to include use of remote sensing techniques for data collection.	The Corps would either accept lead role status or provide lead status on work performance for another agency (e.g., the Upper Mississippi River Basin Commission) in coordination of an annual resource monitoring program. The District might be a central clearinghouse for resource data collection and analysis. Additional remote sensing data collection would be focused on impacts of public use development on land or water resources.
Policy/Funding Item 23	A diversity of recreational opportunities should be provided within the river corridor in developing any management plans.	An updated Corps recreation and resource management plan would focus on the need for providing a diversity of recreation opportunities and experiences. A recommended land use zoning plan would be developed to ensure protection of diverse environments and related recreation uses.	Same as Basic Program.	Same as Basic Program.
Policy/Funding Item 24	Publicly owned recreational boat launching accesses should not be allowed to deteriorate but should be maintained at historic sites when feasible.	The update to the Corps' Master plan for resource development and management would include an assessment of all boat landings and access points located on Corps-owned lands. This assessment would review the quality of service provided and make recommendations regarding operation and maintenance activities. The Corps would continue to provide maintenance dredging of publicly owned marinas, including those having boat accesses, as recommended in the master plan.	State and local units of government would be encouraged by the Corps to survey similar facilities on non-Federal lands to determine which sites should be given priority for government financial assistance toward operation and maintenance activity.	Same as Basic and First Priority Programs.
Policy/Funding Item 25	Uniform standards for floodplain management should be developed for States and municipalities along the GREAT I portion of the Mississippi River. Changes in enabling legislation may be necessary.	The Corps encourages this action. Technical assistance would be provided to communities and States to assist them in this area when requested. Comments and review of proposed regulation changes would be available.	Same as Basic Program.	Same as Basic Program.



Table A-1 - Program actions proposed and/or needed to implement recommendations (cont.)

GREAT I Recommendation	Basic	First Priority	GREAT I
Policy/Funding Item 26			
<p>As part of the ongoing monitoring of GREAT I recommendations, the guidelines adopted by the Upper Mississippi River Basin Commission are endorsed and reprinted below:</p>			
<p>1. The final team report of each GREAT shall be submitted to the Commission through the Great River Study Committee for appropriate Commission action.</p>			
<p>2. The Great River Study Committee will prepare a transmittal report including results of Commission action for submission to the Water Resources Council.</p>			
<p>3. If the Commission chooses to include GREAT reports as components of the approved "regional plan," the GREAT reports must undergo all Public Law 89-30 requirements (including formal 90-day review, revision, and EIS).</p>			
<p>4. If the Commission chooses to accept the GREAT reports and not include the entire package as a component of the "regional plan," the products will be provided to the CCJP Priorities Committee for selective inclusion of the recommendations of GREAT into the approved regional plan. In this case only those components of GREAT that will be included in the regional plan must undergo all Public Law 89-30 requirements (including formal 90-day review, revision, and EIS).</p>			
<p>5. The GREAT reports shall be submitted forward through appropriate channels to Washington and the State governments by the Commission, U.S. Army Corps of Engineers, participating Federal agencies, and States. EIS's may be required for specific actions. These EIS's will be prepared and filed by the appropriate implementing agencies.</p>			
<p>6. The Commission, through the CCJP Priorities Committee, shall monitor progress of the States and Federal agencies in implementing the recommendations of the final GREAT report through its preparation of the annual priorities report.</p>			

The St. Paul District is preparing a transmittal document to submit the GREAT I report to the Chief of Engineers and Congress. This report would facilitate implementation of GREAT I recommendations which pertain to the Corps' operations and maintenance activities.

Same as Basic Program.

Same as Basic Program.

Same as Basic Program.

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont.)

GREAT I recommendation		Basic		First Priority		GREAT I	
Further Study Item 1							
A demonstration dredging project should be conducted during 1980 or 1981 by the St. Paul and Rock Island Districts of the Corps of Engineers to determine the feasibility and cost effectiveness of accomplishing channel maintenance by the following methods:		No major demonstration work is planned unless extra funds become available. Mechanical dredging is being bid under the ICP program to implement the most cost-effective method.		Demonstration dredging will be accomplished at one or more locations using some of the concepts of the four listed methods and possibly other methods. Monitoring and cost-effectiveness evaluations would be included.		Similar to First Priority Program; however, demonstration dredging would be accomplished using the four listed methods.	
1. Mechanical dredging with a barge directly loading onto barges.				Cost is estimated at \$600,000 over a 2-year period to evaluate the data and account for extra costs incurred. The demonstrations would be incorporated as part of an overall equipment evaluation which would allow implementation of the CMP.			
2. Hydraulic dredging with direct loading onto barges.							
3. Mechanical unloading at placement sites.							
4. Hydraulic unloading at placement sites.							
Further Study Item 2						Same as First Priority Program.	
A plan should be developed to use the river's sediment transport capability to cause necessary dredging requirements to occur near long-term placement sites as environmentally and economically feasible		Alternatives are being analyzed at three locations - Lansing Light, Winters Landing, and Heads Landing - looking at modifications to the channel structures, sediment traps, and/or low-head dams on the tributaries to get the material nearer to long-term placement sites or using the sediment transport capability of the river to get material to acceptable locations in the river with the objective of reducing dredging requirements, costs, and/or impacts. On the basis of these studies, plans would be developed at these sites and implemented as funds become available.		Plans developed for Lansing Light, Winters Landing, and Heads Landing would be implemented, and any work accomplished at the sites would be monitored and evaluated to determine effectiveness. Alternatives would be evaluated at other specific sites which appear to have good potential for these types of modifications. On the basis of these additional studies, plans would be developed for the sites where the highest potential applicability exists. Some of these evaluations may depend on the functioning of the one- and two-dimensional sediment transport models and/or a physical model.			
Further Study Item 3							
The Corps of Engineers should continue to develop computerized sediment transport models of the Mississippi River 9-foot navigation system. As models become operational, they should be used to determine optimum depth for dredging at each dredge cut, possible changes in the wing dam system, and other means for reducing dredging requirements.		The one-dimensional model for pools 4 through 8 would be completed and used to evaluate alternatives to reduce dredging requirements. Additional development of the one-dimensional model would continue for the other pools.		The two-dimensional mathematical model would be calibrated and used to evaluate alternatives to dredging at several sites. At some selected sites the models would be used to assist in estimating optimum dredging depths.		The models would be extended as appropriate to all dredge cuts and over the entire length of the 9-foot channel system in the GREAT I area.	

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont.)

Program		First Priority		GREAT 1	
GREAT 1 recommendation		Basic		GREAT 1	
Further Study Item 4		Further Study Item 4		Further Study Item 4	
The Corps of Engineers should initiate dredging at dredge cuts below the confluence of major bed load supplying tributaries when the technical relationships indicate a high risk of potential channel closure. The Corps of Engineers should monitor the deltas at the confluence of such tributaries to determine technical relationships of delta condition, hydrologic occurrences, and risk to downstream channel conditions. The relationships should be applied to determine dredging activities. When a high risk of potential channel closure is determined to exist, dredging should be accomplished with full consideration of the environmental impacts of the dredging and material placement.		A program would be developed to monitor the delta of the Chippewa River and estimate relationships which could assist in estimating the optimum time for dredging to preclude channel closures.		Relationships as described could be established at the deltas of all major bed load supplying tributaries.	
Further Study Item 5		Further Study Item 5		Further Study Item 5	
The condition of all wing dams and closing dams at all historic dredging sites in the St. Paul District should be identified to determine the need for repair and/or modification.		The wing dam conditions and need for modifications are being evaluated at Reads Landing and Lansing Light. Several other sites would be evaluated.		Surveys would be accomplished to determine the existing conditions of wing dams at all historic dredging sites. Model and/or other evaluations would be made at those locations with a potential for reduction of dredging requirements if the wing dams are modified. This work would be coordinated with that described in Further Study Item 2.	
Further Study Item 6		Further Study Item 6		Further Study Item 6	
To reduce dredging requirements, operation of main stem dams or construction of low head tributary dams to create a more favorable Mississippi River stage in relation to tributary stage should be investigated.		No action is planned on operational modifications to main stem dams for this purpose (also see Further Study Item 28). Low head dam studies would be accomplished as described in Action Item 11.		Main stem dam operation studies would be conducted for the 13 dams in the GREAT 1 area. Low head dams on all major tributaries would be evaluated.	

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I recommendation	Program	
	Basic	First Priority
Further Study Item 7		
The Corps of Engineers should investigate the possibility of sand and gravel companies accomplishing the dredging required for channel maintenance.	The Corps would cooperate with the sand and gravel companies that operate along the river in determining the desirability and/or capability of the sand and gravel companies to modify their operations to remove material which could reduce the volumes that would require removal to maintain the 9-foot channel.	The Corps would develop, in cooperation with the sand and gravel companies, base information and potential alternative plans which would demonstrate to the sand and gravel companies how their operation could benefit by application of the plans for dredging from an area that would reduce dredging requirements for the 9-foot channel.
Further Study Item 8		
The Corps of Engineers should continue monitoring dredging and material placement activities to further determine impacts on water quality. Parameters tested, as agreed to by an interagency coordinating committee, should be used in correlation with the existing knowledge base and with site-specific sediment and hydraulic characteristics to develop a predictive capability of water quality impacts related to dredging and material placement. When such predictive capability is established, water quality criteria and standards should be reviewed and revised.	See Action Item 9.	Lead effort would be required from the Environmental Protection Agency and/or the States. The Corps would participate in studies to develop water quality criteria and standards for dredging and material placement.
Further Study Item 9		
A follow-up to the Corps of Engineers "Streambank Erosion Site Inventory" should be conducted cooperatively between the Soil Conservation Service and the Corps of Engineers to determine and classify streambank erosion sites not previously identified. Alternatives for bank erosion control could be developed and analyzed for economic and environmental impacts. Implementation authority and cost-sharing criteria should be developed so that control alternatives can be implemented.	The streambank erosion control demonstration program would be completed. No further action is planned.	A joint program between the Corps of Engineers and Soil Conservation Service could be developed to follow up the Streambank Erosion Site Inventory. Other aspects of this recommendation could also be developed.

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont.)

GREAT I recommendation	Basic Program		First Priority Program	
	Further Study Item 10		Further Study Item 11	
The feasibility of bed load sediment entrainment structures (rock gabions, low head dams, etc.) should be investigated on lower reaches of intermittent or seasonally dry tributaries on the Wisconsin side of pool 1.	Further Study Item 10	No action is planned for these specific tributaries. Also, see Further Study Item 6.	Same as Basic Program.	A study would be undertaken to determine the relationship of the source of the sediment and the dredging requirements in pool 1. This study would be incorporated with other studies dealing with tributary sediment supplies. If a significant relationship is found, a feasibility analysis would be conducted.
		The Corps would work with the States to get the necessary approvals to select a site for test dredging using riverine placement techniques. Monitoring of the site would be accomplished. Also, the results of similar testing in the GREAT II reach would be evaluated for application in the GREAT I area. Where appropriate this technique would be considered for use and modifications to the CMP proposed. (Cost - about \$50,000 over 2-year period.)	Same as Basic Program.	The Corps would work with the States to get the necessary approvals for part of a pilot program to test various dredging techniques. Two sites would be programmed for dredging and monitoring to determine effectiveness. Monitoring would include 2 years of pre-site and downstream comprehensive monitoring. (Cost - \$400,000 over a 4-year period.)
The feasibility of removing material from existing placement sites in the floodway, where there is potential for flood flow impacts, should be investigated.	Further Study Item 12	Computer model HEC-2 is being developed for pools 4 and 5 and would be used to estimate the potential effects of proposed placement of dredged material on flood levels. If placement would cause major changes in flood levels, alternatives to minimize the adverse effects would be evaluated.	Data would be gathered to extend HEC-2 to all pools in GREAT I area. If future operations would increase flood levels, the economic and social consequences of the increases would be evaluated as well as possible actions which might minimize such effects.	Similar to First Priority Program with more emphasis on the evaluation of the feasibility of removing material from floodway.
		At limited specific sites where a high demand exists and where it is practical with existing equipment capabilities and funding constraints, studies would be accomplished. For example, at Reads Landing, evaluations would be done to determine the best method of using placement site 4.24, a site which has a greater potential for beneficial use than the historic placement sites. Material from past placement as well as future dredging would be considered.	Studies would be accomplished at several sites, in accordance with the CMP.	Similar to First Priority Program but with a greater number of sites.
When the need for transporting dredged material to an area of high demand has been identified at a specific site, a feasibility study should be made to determine the best means of providing the desired material. Sources to be considered for the material should include historic placement sites as well as proposed dredging operations. All potential methods of moving the material should be considered including rail, truck, pipeline, and barge. Such studies will involve an environmental assessment of impacts.	Further Study Item 13			

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I recommendation		Program		GREAT I	
		Basic		First Priority	
<u>Further Study Item 14</u>					
Private enterprise should be encouraged to explore the economic feasibility of transporting sand from dredged material islands to the area of demand.	The Corps would not change current policies and programs. Information would be provided to private enterprise on the location and characteristics of the dredged material.	Same as Basic Program	A more detailed program would need to be developed to work with private enterprise in finding economical and beneficial manners for them to use the material. This program could provide a detailed evaluation of the physical properties of the material and methods to remove the material so that it would benefit the private enterprise.		
<u>Further Study Item 15</u>					
The feasibility of using riprap made with dredged material and cement should be investigated.	No further action is planned. If economic considerations change, additional consideration might be given at specific sites where bank stabilization or riprap is required.	Same as Basic Program.	The work conducted in the GREAT II studies on this topic would be evaluated for applicability to the GREAT I area and further evaluations conducted as needed.		
<u>Further Study Item 16</u>					
The potential beneficial uses of fine organic sediments should be studied. The study should address the problems of contaminants and dewatering, often associated with fine organic material, and the possible effects dredging may have on biological productivity at the dredging site.	The potential for beneficial uses of the fine organic sediments at future sites to be dredged for maintenance of the 9-foot channel would be evaluated on a case-by-case basis.	Same as Basic Program.	A study could be conducted to address the potential for beneficial uses of fine organic material that would be dredged in conjunction with specific recreation and/or fish and wildlife enhancement projects. The Corps could take the lead effort in the conduct of these studies.		
<u>Further Study Item 17</u>					
A concurrent two-part program should be conducted in the GREAT I critical sediment source area to determine the feasibility of large-scale use of conservation tillage farming systems to reduce the sediment yield to the Mississippi River.	The lead effort is with other agencies; however, the Corps would cooperate with the agencies involved in the two-part program and provide technical review and assistance where authority and funding allow.	Same as Basic Program.	Same as Basic Program.		

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT A Recommendation	Program	
	First Priority	GREAT I
Further Study Item 18 Monitoring of sediment inflow from major tributaries should be continued and additional stations established. The Corps of Engineers should review all tributaries with a coordinating committee to establish priorities for additional sediment sampling stations.	Basic The existing Corps involvement in sediment sampling on the tributary streams would be reviewed. This review would be coordinated with other interested and involved agencies. If the review indicates that changes are necessary, the program would be modified as necessary to ensure that the data gathering is being accomplished to provide a data base which would assist in analyzing problems related to sediment transport and maintenance of the 9-foot channel.	Same as Basic Program.
Further Study Item 19 The feasibility of protecting critical backwater areas from sedimentation should be studied.	Basic Coordination would be provided on any studies accomplished by Fish and Wildlife Service.	Same as Basic Program.
Further Study Item 20 A program to evaluate dredging and island creation in backwater areas for restoration purposes should be developed.	First Priority The Fish and Wildlife Service would have to provide the lead effort. The Corps would provide technical input and review. The Corps would participate in funding and construction of feasible projects if authorities allow.	Same as First Priority Program.
Further Study Item 21 The Weaver Bottoms rehabilitation proposal (Nelson et al., 1978) should be implemented when it can be documented that the impacts, including those on flood stages, water quality, biological productivity, and sedimentation, are acceptable to the affected States and Federal agencies.	Basic The Corps would coordinate and cooperate with Fish and Wildlife Service and the States in developing such a program.	Same as Basic Program.
	First Priority The Corps would participate in feasibility studies with funding, planning, technical input, and review. The Corps would participate in construction of closure structures if a plan is acceptable and feasible using Public Law 89-72 authorities which require a local sponsor or Section 150 of the Water Resource Development Act of 1976 which has a \$400,000 limit.	Same as Basic Program. If the local sponsor or non-Federal sponsor requirements change, the revised requirements would be used.

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT I recommendations	Program		GREAT I
	Basic	First Priority	
Further Study Item 22			
The potential of using the Finger Lakes at the dike of lock and dam 4 as a "physical model" for backwater management techniques which have been, and may be proposed for the future should be investigated.	Corps would coordinate with the Fish and Wildlife Service and the States in their evaluation.	Same as Basic Program.	Same as Basic Program.
Further Study Item 23			
The best means for reducing fine sediment flow into Big Slough (river mile 670.5, Iowa) while keeping the slough open to fishing boats should be determined and implemented.	The Corps would evaluate methods to reduce dredging needs downstream of the inlet to Big Slough and coordinate the evaluation with the Fish and Wildlife Service and the State of Iowa. Any major evaluations on the resource enhancement of Big Slough would be deferred to the Service and/or the State of Iowa. Limited technical input and review and comment on any proposals would be provided. The Corps would participate in funding and construction if a local sponsor is identified and the project is justifiable using Public Law 89-72 authorities.	The Corps would take an active lead role with the Fish and Wildlife Service and/or the State of Iowa in developing conceptual solutions to the problem under Public Law 89-72 or Code 710 authorities. The Corps would participate in funding and construction if a local sponsor is identified and the project is justifiable using Public Law 89-72 authorities.	Same as First Priority Program. If the cost sharing or non-Federal sponsor requirements change, the requirements would be revised.
Further Study Item 24			
The impact of altering the cuts between the islands separating Lake Onalaska from the main channel of the Mississippi River should be investigated. Structural measures should be built if the results of the investigation determine that the alterations would benefit Lake Onalaska.	The Corps would: 1. Defer lead study effort to the Fish and Wildlife Service and/or the State of Wisconsin. 2. Provide limited technical input as requested. 3. Review and comment on any proposals developed. 4. Participate in funding and construction if a local sponsor is identified and the project is justifiable using Public Law 89-72 authorities.	The Corps would: 1. Take an active lead role with the Fish and Wildlife Service and/or the State of Wisconsin in developing conceptual solutions to the problem under Public Law 89-72 or Code 710 authorities. 2. Participate in funding construction if a local sponsor is identified and the project is justifiable using Public Law 89-72 authorities.	Same as First Priority Program. If the cost-sharing or non-Federal sponsor requirements change, the revised requirements would be used.



Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GREAT 1 recommendations		Basic		First Priority		GREAT 1	
Further Study Item 25	Congress should provide funds to the Corps of Engineers to study the feasibility of rehabilitating the <u>Spring Lake</u> area of pool 2.	The Corps would: 1. Study and implement methods to reduce dredging needs at the head of Spring Lake or provide for beneficial use of dredged material. 2. Defer lead effort on lake rehabilitation to the State of Minnesota. 3. Provide limited technical input as requested. 4. Review and comment on any proposals developed. 5. Participate in funding and construction if a local sponsor is identified and the project is justifiable using Public Law 89-72 authorities.	The Corps would: 1. Take an active lead role working with the State of Minnesota in developing conceptual solutions to the problem under Public Law 89-72 or Code 710 authorities. 2. Participate in funding and construction if a local sponsor is identified and the project is justifiable using Public Law 89-72 authorities.	Same as First Priority Program. If the cost sharing or non-Federal sponsor requirements change, the revised requirements would be used.			
Further Study Item 26	The monitoring program at Kruger Slough and Island 42 should be continued to document effects of opening side channels.	The Corps would continue to coordinate with the Fish and Wildlife Service and the States in the data being collected in the monitoring program.	Same as Basic Program.	Same as Basic Program.			
Further Study Item 27	The distribution of submerged aquatic vegetation, invertebrates (including clams), bottom types and depths, and submerged physical features of the river should be <u>mapped</u> .	Mapping of the main channel border features (depth, wing dams, and substrate) would be done in pool 5A.	Mapping of Main channel border structural features would be accomplished for localized areas of lower pool 4 through pool 10.	The main channel border feature for entire project area from pool 10 upstream would be mapped. This would be coordinated with the mapping of other river features by other agencies.			
Further Study Item 28	The means of controlling the pool water levels for the benefit of fish and wildlife and recreation in harmony with the 9-foot channel project should be investigated. If such control is found feasible, the Corps of Engineers, Fish and Wildlife Service, and the States should pursue an agreement to implement this practice. In the interim, fish and wildlife should be considered in pool fluctuations presently being done for other purposes on the river.	Coordination with Fish and Wildlife Service on operations of pool levels would be improved.	A study on water level fluctuations for at least one pool would be accomplished to determine if pool operations could be changed to benefit fish and wildlife and recreation in harmony with the navigation project. The results of this analysis would be used to determine if modifying the operation plans and/or agreements with the States and the Fish and Wildlife Service should be done.	Same as First Priority Program, except the studies would be conducted for all pools in the GREAT 1 area.			

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

GENERAL Recommendation		Basic		Program	First Priority	GENERAL
Further Study Item 29 Primitive or natural areas should be identified and follow-up designations made where appropriate.	Review and comment would be provided on any proposals developed by other agencies.	Same as Basic Program.	The Fish and Wildlife Service or States would have to take the lead action. The Corps would participate as needed.			
Further Study Item 30 Forest management should be considered in the Upper Mississippi River Basin Commission River System Master Plan.	The Corps' updated recreation and resource management plan would be coordinated with the Upper Mississippi River Basin Commission.	Same as Basic Program.	Same as Basic Program.			
Further Study Item 31 A study should be conducted to determine the most effective techniques for management of bottomland hardwoods for wildlife.	The Corps' updated master plan for public use development and resource management would include a forestry management appendix. The preparation of the study element would include an inventory of forest units along the river on Corps-owned lands and identification of a first stage level plan for forestry management. Forestry management objectives would include wildlife enhancement on lands deemed appropriate for that purpose.	Same as Basic Program.	The Corps could take a lead role in the development of a coordinated forestry management plan with the assistance and support of all major public land management agencies having jurisdiction in the study area.			
Further Study Item 32 The life history of the fishes of the Upper Mississippi River should be studied.	No action planned.	Same as Basic Program.	Same as Basic Program.			
Further Study Item 33 The Corps of Engineers, Wisconsin Department of Natural Resources, U.S. Fish and Wildlife Service, and Vernon County should develop an agreement for placing culverts and opening side channels to Blackhawk County Park near Victory in pool 9.	Funds would be programmed for the installation of a culvert. Coordination is being continued with the Fish and Wildlife Service, Wisconsin Department of Natural Resources, and Vernon County.	The Corps would: 1. Defer lead study effort for actions beyond installation of the culvert and resolution of historic dredged material placement to the Fish and Wildlife Service and/or the State of Wisconsin. 2. Provide limited technical input as requested. 3. Review and comment on any proposals developed. 4. Participate in funding and construction if a local sponsor is identified and the project is justifiable using Public Law 89-72 authorities.	Same as First Priority Program. If the cost-sharing or non-Federal sponsor requirements change, the revised requirements would be used.			

Table A-1 - Program actions proposed and/or needed to implement recommendations (cont)

Program		First Priority		GREAT I	
GREAT I Recommendation		Basic		First Priority	
<u>Further Study Item 34</u>					
Aesthetics of the area should be protected as part of any management plan for the Mississippi River.		The Corps' update to its recreation and resource management plan would include an aesthetic management plan as an appendix. This plan would include land use protection guidelines to both protect and enhance the natural scenic qualities of the river environment.		The appendix discussed in the Basic Program would be expanded to include the planning process recommended by the GREAT I Recreation Work Group.	
The District would take a lead role in coordinating an aesthetic management plan with other non-Federal interests who control the majority of lands and adjacent water areas which would be affected by protective land use zoning.				Same as First Priority Program.	
<u>Further Study Item 35</u>					
Congress should direct the Department of Transportation or the Corps of Engineers to review Federal, State, and local regulations pertaining to commercial navigation, terminals, and support facilities with a view toward defining more clearly the areas of jurisdiction and proposing the elimination of conflict areas as appropriate.		The Corps would cooperate with the Department of Transportation in this study. Ongoing coordination efforts with other regulatory agencies, both State and Federal, to combine forms and use the same data to minimize the item required for the processing of permit applications would be continued.		Corps would take lead effort in development of the study.	
Same as First Priority Program.				Same as Basic Program.	
<u>Further Study Item 36</u>					
A study to identify acceptable floating areas to meet present regional shortages and future regional needs should be conducted.		The Corps would cooperate and coordinate with agencies involved in such a study to ensure that all information in Corps files is available for the study.		Same as Basic Program.	
Same as Basic Program.				Same as Basic Program.	
<u>Further Study Item 37</u>					
The Coast Guard should study the feasibility of establishing a marked channel for commercial transportation vessels in Lake Pepin.		The update to the District's master plan for recreation and resource management would address user conflict areas, including any which may occur on Lake Pepin. Recommendations for the control or reduction of user conflicts, where appropriate, would be directed to the Coast Guard and other responsible local land management agencies.		Same as Basic Program.	
Same as Basic Program.				Same as Basic Program.	
<u>Further Study Item 38</u>					
The Corps of Engineers should conduct feasibility studies and make recommendations to Congress which address projected capacity limitations at locks and dams 2 and 3 caused by demand increases for commercial and recreational craft.		The Corps would request additional funding to complete the Small-Craft Lock Study which addresses the problems at these run as well as the other locks in the GREAT I area.		Lockage waiting areas would be considered at locks and dams 2 and 3. Also see Action Items 14 and 20. These actions would be coordinated with the Corps' recreation and resource management plan and with the Upper Mississippi River Basin Commission master planning efforts.	
Same as First Priority Program.				Same as First Priority Program.	

Table A-1 - Program actions proposed and/or needed to implement recommendations

GREAT I Recommendation	Program		GREAT I
	Basic	First Priority	
Further Study Item 39			
The U.S. Coast Guard should re-assess its capability to operate and maintain the navigational aid system within its national aid system within its currently available resources and seek additional capability if necessary.	The Corps would cooperate with the Coast Guard in ensuring that the navigational aid system is adequately maintained.	Same as Basic Program.	Same as Basic Program.
Further Study Item 40			
The Upper Mississippi River Basin Commission should coordinate the development of a recreation master plan for the Upper Mississippi River System for implementation by appropriate lead agencies.	The St. Paul District would coordinate its recreation and resource management master plan with the Upper Mississippi River Basin Commission.	Same as Basic Program.	Same as Basic Program.
Further Study Item 41			
A determination should be made based on unified resource management objectives (phase I of recreation master planning development) of the feasibility and acceptability of the recreation sites listed in Exhibit 6 to determine which should be funded for implementation to meet existing recreational demand and need. When determined appropriate, specific recreational developments should be immediately implemented.	Site-specific recommendations of GREAT I will be reviewed and taken into consideration in preparation of the updated Corps recreation and resource management plan.  Suitable projects which can be implemented without cost sharing by existing Corps authority will be recommended for action as funding becomes available.	The Corps would seek out potential cost-sharing sponsors for implementation at GREAT I recommended sites where Corps-owned lands are involved and which are recommended for implementation in the recreation and resource management plan.	Same as First Priority Program.
Further Study Item 42			
Water surface use in pools or portions of pools where conflicts exist should be identified and zoned. No wake zones or restricted use areas should be established in constricted areas and/or where heavy recreation use occurs.	The update to the Corps' recreation and resource management plan would include an inventory of water surface use conflict areas. The master plan would focus on the appropriate use of shoreline areas adjacent to such sites in an attempt to reduce user conflict.  Recommendations would be made, where warranted, to local authorities to implement water surface zoning re...	Same as Basic Program.	Same as Basic Program.

Item 43

Further Study Item 43  
Further studies which focus on the economic and social benefits and environmental impacts of private leases on general land should be conducted. Such leases should be phased out when a needed public use can be demonstrated.

The potential conflicts of private leases with beneficial public use of Corps-owned land would be reviewed in the update of the recreation and resource management plan. Applications for new leases or renewal of existing leases would consider such conflicts and where the public use would be adversely affected the leases would not be issued.

Same as Basic Program

Same as Basic Program.

Item 44

Further Study Item 44  
Funds should be provided to the Upper Mississippi River Basin Commission to study the feasibility of mathematical models for floodplain management, including the Compound Stream Flow Model, and develop a work(s) base on the findings and recommendations of the study.

The Corps would review proposals and evaluations of the Basin Commission and cooperate to the extent funds would allow. The results of the HEC-2 computer model and other analysis would be coordinated with the Basin Commission's efforts.

Same as Basic Program.

Same as Basic Program.

Item 45

A comprehensive cultural resources inventory of known sites in the GREAT I area should be done as input to future management decisions.

A cultural resource literature search and survey of the river corridor would be conducted in the St. Paul District for areas affected by the 9-foot channel navigation project.

Same as Basic Program.

Same as Basic Program.

Item 46

The Upper Mississippi River Basin Commission should examine the feasibility of using the Geographic Information System (GIS) as a land and water use management tool.

No action planned.

Same as Basic Program.

Same as Basic Program.

Item 47

Land ownership and management responsibility within the river corridor should be documented.

In the recreation and resource management plan update, land ownership and management responsibility for those lands owned by the Corps, including general plan lands, would be documented.

Same as Basic Program.

Same as Basic Program.

APPENDIX B

DESCRIPTION OF GREAT I CHANNEL  
MAINTENANCE PLAN AND EQUIPMENT NEEDS

UPPER MISSISSIPPI RIVER AREA  
(HEAD OF NAVIGATION TO GUTTENBERG, IOWA)

ST. PAUL DISTRICT  
U.S. ARMY CORPS OF ENGINEERS  
JUNE 1981

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## APPENDIX B

### DESCRIPTION OF GREAT I CHANNEL MAINTENANCE PLAN AND EQUIPMENT NEEDS

#### DESCRIPTION OF GREAT I CHANNEL MAINTENANCE PLAN

##### GENERAL

The GREAT I Channel Maintenance Plan (CMP) is a dredged material placement plan. Specific sites are recommended for placement of material projected to be dredged from the historic dredging sites for the period 1985-2025. Each site has a defined area and depth of fill which were used for evaluation. Where more than one placement site is designated, a sequence of site use is provided. It is projected that material will be removed for beneficial use and will reduce the total capacity required. For high frequency dredging sites, temporary sites are identified for restricted use to allow channel maintenance when the permanent sites cannot be used because of equipment or time frame limits. The CMP and designated placement sites are a good basic plan; however, the plan must be flexible and placement sites can be changed with appropriate coordination and evaluation.

##### PROJECTED DREDGING REQUIREMENTS

GREAT I projected average annual dredging requirements of 836,000 cubic yards with implementation of the CMP. This amount is significantly less than the historic average of 1.5 million cubic yards per year for the last 30 years.

A review of dredge cuts for which GREAT I projected a volume reduction over 50 percent indicates three significant factors contributing to the reduction:

1. Reduced-depth dredging.
2. Sediment reduction from Chippewa River sediment control measures.
3. Reduced channel width.

GREAT I estimated a 15-percent reduction for the period 1975-1985 and an additional 10-percent reduction for 1986-2000 from reduced-depth dredging. At certain locations, the reduction was not applied because structures posed potential safety hazards. Although the reduction may not be accurate at certain locations, it is considered reasonable as an average over the total system on the basis of the results of GREAT I research and pilot programs. Accuracy of projections at individual sites cannot be refined without further research; however, any inaccuracy may affect long-term placement site capacity and equipment requirements if the error is made at sites requiring particular equipment.

Estimated reductions in dredging at specific sites because of a reduction in the Chippewa River sediment supply are given in the table on page 46 of Volume 8, Part I, of the Channel Maintenance Appendix to the GREAT I report. However, GREAT I did not include dredging in the Chippewa River for a sediment trap or low-head dam (the most probable means of controlling the sediment supply). Dredging volumes in pool 4 would be significantly reduced by tributary sediment control on the Chippewa River. Appendix C of this report discusses these measures. GREAT I has estimated the reduction at 72,800 cubic yards annually. This amount should be added back in to account for dredging on the tributary.

Reductions in dredging quantities resulting from reductions in bend width are shown in the table on page 40 of Volume 8, Part I, of the Channel Maintenance Appendix. The basis of computation for a river bend where shoaling occurs on the inside of the bend is considered to be well refined. The computation accounts for the typical dredge cut which is heavy on the inside of the bend and feathers out to good channel depths on the outside of the bend. However, three sites included in this computation have uniform dredge cuts across the channel and are not typical river bend sites: Crats Island (pool 4), Winters Landing (pool 7), and above Brownsville (pool 8). In these cases, the projection should be based on a direct relationship of historical width maintained to the modified width. The following adjustments should be made:

Crats Island, cut 4, pool 4	=	+11,200 cubic yards
Winters Landing, cut 4, pool 7	=	+6,000 cubic yards
Above Brownsville, cut 6, pool 8	=	+2,000 cubic yards
		+19,200 cubic yards

With the two preceding adjustments, a modified GREAT I dredging volume projection would be 928,000 cubic yards on an average annual basis.

GREAT's projections may be reasonable on the basis of available research, pilot program results, and professional judgments; however, individual site requirements may vary significantly. The maintenance plan must be able to be adjusted on the basis of experience and additional information.

#### RELATIONSHIP OF CHANNEL DREDGING SITES TO DESIGNATED PLACEMENT SITES

The GREAT I CMP basically requires that dredged material be transported longer distances to avoid or minimize impacts on wetlands and maximize beneficial use of the material. On the average, dredged material has been transported approximately 1.1 miles from the dredging site. The CMP was reviewed considering the following factors:

1. Average annual quantities were split among multiple placement sites where alternate sites posed a significant distance change.
2. The Chippewa River sediment trap would be located at the delta, and dredged material would be placed in the Wabasha Gravel Pit. The distance of 10,500 feet was shown under the 2- to 3-mile category.
3. It was assumed that alternative placement sites could be used to avoid the 25-mile haul distance of surplus material in pool 9.

The following table summarizes the distances from dredge cuts to the placement sites recommended in the CMP. The average transport distance is 2.8 miles.

Table B-1 - Summary of volumes of dredged material and distances from dredge cuts to GREAT I CMP placement sites

Distance to placement	Average annual quantity dredged (cubic yards)	Percent of material handled in GREAT I area
Less than 5,000 feet	149,000	16
5,001 to 10,000 feet	262,000	28
2-3 miles	269,000	29
3 1-4 miles	60,000	7
4.1-6 miles	74,000	8
6 6-8 miles	76,000	8
Greater than 8 miles	38,000	4
Total	928,000	100

The CMP was evaluated as a whole and also considering specific information such as locations of dredge cuts, historic and projected volumes, frequency of dredging, CMP placement sites, site ownership, distance from the dredge cuts over water and over land to the placement sites, approximate placement site elevations, capacity, beneficial use removal required, feasibility of hydraulic placement, pipeline and barge site accessibility, feasibility of hydraulic rehandling access, trucking required, features to gain access, berming needs to retain dredged material, and special considerations. The evaluation used the best information available, but the sites were not inspected. The evaluation indicated several potential limitations of the CMP which must be addressed by all concerned interests to make the CMP workable. Some of the major limitations are discussed in the following paragraphs.

## CMP LIMITATIONS

### Placement Site Availability

GREAT I selected the CMP sites with limited consideration or investigation of the availability of the sites. The major emphasis was on choosing sites near population centers where greater beneficial use is expected. Most of the sites selected are not owned by the Federal Government.

Many factors could prevent or impair use of a particular site:

1. If the landowner opposes material placement the site may have to acquire placement rights by condemnation, a time-consuming process. In addition to acquiring placement rights at the site, land-use controls are needed for the access route required to get material to the site and possibly for an access to allow material removal.
2. The landowner may want material placed on his property but his future plans may not be compatible with the CMP. For instance, the landowner may not allow material to be removed. Material removal may have been anticipated in the development of the CMP to ensure adequate capacity for the entire time frame. Land use plans may also restrict the time frame or area available for material placement.
3. Use of a number of sites is contingent upon further studies or approval of another project planned for that site. Details between agencies must also be resolved in some instances.
4. The CMP lacks any analysis of the social impacts of use and acquisition of selected sites. At many locations, placement and material removal will interfere with surrounding land use. Local zoning ordinances may prohibit certain proposed operations. Adverse public attitude could result from actions required to implement the CMP such as land condemnation or overland transportation through populated areas.
5. The demand for material may diminish if a cost for providing it must be charged.

### Regulatory Responsibilities

The CMP was developed with the intention of selecting the best compromise site from a number of alternatives which represented a variety of interests. Compliance with existing regulations was not fully considered in the selection process. Placement at many sites will require a change in or exception to present State regulations. Changing these regulations may be difficult and time consuming. Detailed site-specific evaluations are needed to comply with Federal regulations.

Uniform water quality standards for dredging do not exist. The CMP does not recommend establishing specific standards. Thus, use of many sites and methods will require a resolution of acceptable standards between agencies involved.

A floodplain analysis is necessary at many sites to determine if significant impacts will result from long-term material placement. An evaluation for compliance with State and local floodplain ordinances is needed, to allow non-Federal landowners to obtain necessary permits.

### Implementation Guidelines

The CMP lacks detailed guidelines for implementation. Operational or development plans must be formulated for each site. These plans will have to be acceptable to concerned agencies and any interested parties. A beneficial use program will have to be established. Site-specific plans will require a clear definition of responsibility to ensure its success, including participation by other agencies.

Recommendations for equipment were provided and analyzed only on a site-specific basis. The total system must be analyzed to develop an equipment package that can meet the overall CMP requirements. This report includes an initial system analysis. However, because it is not a part of the GREAT report, it will have to be reviewed, refined, and accepted by other agencies.

The CMP identifies a placement site(s) for each dredge cut. Different methods for moving the material from the cut to the site are not fully evaluated. In most cases, some type of rehandling is involved. Rehandling methods vary in cost and environmental impacts and must be compared. Locations for rehandling also have to be designated, evaluated, and approved.

#### Physical Restrictions

A number of physical challenges facing placement site use must be met. The dimensions of the sites were primarily determined from the volume projected for placement. Detailed site surveys are needed to refine these estimates. Where capacity was overestimated or where dredge cut projections are underestimated, additional area or placement sites will be needed.

The dredging volumes projected for the sites are based on average quantities. The capacities of the sites were not adjusted to accommodate a maximum job size or multiple jobs programmed for certain sites. This could be a problem especially at small sites where material has to be removed.

Where annual removal is required, secondary sites have not been provided. Also, if removal by beneficial use is not as prevalent as anticipated, secondary or alternate sites will be needed.

Physical restrictions have not been completely identified in the CMP and will have to be resolved before placement is viable. Site drainage, accessibility, and off-shore water depth are some of the restrictions which might require substantial engineering, planning, and construction before the site can be used.

#### Conditional Use Requirements

Nearly all of the sites have conditions attached which significantly limit when and how the sites should be used. At some sites, placement is limited to a specific area or for a specific purpose. Annual or seasonal removal of the material is necessary at some sites. The CMP does not establish responsibility for rehandling.

Some sites were selected because material is needed at that location for use in an ongoing or planned project. Placement at these sites will have to be coordinated with the projects.

Requirements for stabilization of material must be analyzed, designed, and additional funding provided with site development.

#### Cost Data

Realistic cost data are needed to allow a Section 404 evaluation and determine if funding is justified. Some data were developed but need to be refined. Reliable estimates are needed for equipment alternatives comparison, site preparation measures, access requirements, and conditional use requirements before the specific equipment, placement site acquisition, etc., can actually proceed to implementation. No cost information is available for use of the temporary placement sites identified or for material removal from these sites as an advance preparation measure. As the CMP is programmed for implementation on a site-by-site basis, the site-specific and equipment recommendations will require additional support and justification. Variations from the CMP as described in the GREAT I report are expected as additional information is obtained.

### DREDGING EQUIPMENT

#### MECHANICAL

##### General

This section discusses mechanical dredges, specifically cranes and backhoes. Other mechanical dredges (such as bucket ladder, pneuma pump system, and dipper or shovel dredges) are more useful in mining, spot cleanup of hazardous material, rock excavation, channel construction, and similar situations where volumes are high and cut faces are maximum.



Five distinct dredges can be evolved from the crane and backhoe:

1. Crane with clamshell bucket.
2. Crane with orange peel bucket.
3. Crane with dragline bucket.
4. Backhoe with open digging bucket.
5. Backhoe with hydraulically activated clamshell bucket.

The orange peel bucket is actually a form of grapple and is used primarily when rock, corestone, or similar materials smaller than derrickstone are to be removed. The dragline bucket is used primarily to cut a trench or excavate where accuracy of cut depth is not an overriding factor. Therefore, the crane with a clamshell bucket and the backhoe with an open digging bucket or hydraulically activated clamshell are the three primary units to consider for shallow face maintenance dredging.

#### Suitability

The major factor that makes mechanical dredging very popular for maintenance dredging is that it excavates the bottom material in an "in situ" condition. "In situ" means the material is removed in a condition and density similar to that in which it is found on the riverbed. The volume handled is at a minimum, the material can be loaded into barges with ease, and water rehandling or processing is minimized.

Mechanical dredging is a straightforward process with minimal set-up time. The set-up time for rehandling will be more complex and longer. Mechanical dredges have relatively low initial investment costs.

The primary disadvantage of conventional mechanical dredging is relatively low production rates. The bucket only excavates during a small portion of the cycle. The balance of the time is spent traveling to and from the placement vehicle.

Mechanical dredging is also very labor intensive because operation of independent equipment is required with the dredging, barge transport, barge unloading, and subsequent rehandling to a final placement site.

A major consideration with mechanical dredging is suitable facilities to unload the barge and the location of the final placement site in relation to the unloading facility. The unloading and secondary transport requirements are a major factor in selecting the basic dredging method and rehandling approach.

#### Production

Production capabilities of the three units are readily available from various manufacturers. Generally a backhoe duty cycle is about one-half that of a crane. The hydraulic clamshell on a backhoe adds about 10 percent to its production rate because the hydraulic clamshell opens and closes faster on the ends of the cycle than the open digging bucket can curl and uncurl. This advantage can be lost, however, when faces are shallow (less than about 2 feet). For comparison, the following table lists the production rates of several machines.

Table B-2- Production rates of mechanical dredges

Manufacturer	Model number (1)	Manufacturer's rated operating capability (cubic yards per dredg- ing hour)	Monthly estimated rated dredging capacity (cubic yards)
<u>Backhoe</u>			
Link Belt	LS 4800 (S)	204	69,000
Link Belt	LS 5800 (M)	252	76,000
Link Belt	LS 7400 (L)	450	117,000
American	25 (S)	180	61,000
American	480 (M)	270	81,000
American	45A (L)	450	117,000
Caterpillar	235 (M)	270	81,000
Caterpillar	245 (L)	360	93,000
<u>Crane</u>			
Link Belt	LS 318 (M)	225	67,000
American	599 (S)	180	61,000
American	7250 (M)	272	82,000

(1) Letter in parentheses indicates large (L), medium (M), or small (S).

The manufacturer's rated operating capability is based on a reduction of the optimum production considering an 18-foot digging depth below tracks, 90° rotation, maintenance dredging on a shallow face, and generally a 50-minute operation per hour. This rating was reached following discussion with and concurrence by technical representatives of manufacturers in the Twin Cities area. This rate is 30 to 40 percent below the optimum production rates under optimum production conditions. GREAT I production rate data did not adequately consider this factor.

Figures in the column labeled "Monthly estimated rated dredging capacity" are from a study of effective dredging time of the Derrickbarge Hauser conducted for the period 1963-1973. The Hauser operates at approximately 200 cubic yards per effective dredging hour. Effective dredging time was 57.6 percent of the total time. The balance of the time consisted of mobilization, stepping, switching, mechanical breakdowns, opposing weather and navigation, securing of plant for nonwork periods, etc. Effective dredging time will be greater with smaller capacity units and less with larger units because the fixed hours of downtime (such as mobilization, switching, and stepping) will have a greater impact on larger units. A reasonable estimate of effective dredging time is 50 percent for large, 57.5 percent for medium, and 65 percent for small units. The estimated monthly rated capacity in the final column of the above table is for a 5-day, 24 hours per day operation. Increased efficiency in stepping, switching, and barge size could raise efficiency by 5 to 10 percent of total time. As suggested previously, the backhoe rates could be increased up to 10 percent if a hydraulic clamshell instead of an open digging bucket is used.

#### Selection

A number of factors must be considered when selecting the equipment to be used for working in the dredge cut. Use of the fastest unit would be considered first. The consensus of manufacturers' representatives was that using the three large size backhoes for maintenance dredging was an "oversized" situation. These machines were designed to work in situations where maximum reaches, cuts, and faces and minimum movement of the machine would occur. Present dredging cuts with light faces of about 2 feet could not possibly load the machines to full bucket capacity. The problem with

trying to use the small machines as dredges is that the machines must be equipped with extra length booms and sticks because they are basically designed to dig from track level down. In dredging, the machine is on a barge and the freeboard and water depth prohibit operation of a standard machine. Therefore, a medium-sized hydraulic backhoe with its fast cycle time appears best suited to mechanical dredging in the CMP.

The hydraulic backhoe has several disadvantages in comparison to a conventional crane. Repair of backhoes is more technically demanding than repair of cranes because of the more exact tolerances involved in the hydraulic equipment. Thus, field repair of the backhoes may be limited. A crane can be used for other purposes when it is not being used for dredging. Cost savings in construction of the work barge can be realized when using the crane as opposed to using a backhoe. The forces on the barge, barge spud wells, and spuds are primarily vertical when using a crane. However, the capability to resist the reactive horizontal forces that the backhoe produces must be incorporated into the barge and its equipment, thus adding to the original cost of the barge. A factor favoring the crane is that the machinery usually gives warning of failures by noise of brake or clutch slippage. In many instances, adjustments to the clutches and brakes can be delayed to a weekend when machine use would not be interrupted. However, when hydraulic equipment malfunctions slightly the machine should be attended to immediately to preclude a major repair expense. Shutdowns could happen regardless of the urgent need to continue dredging. The possibility of a rupture in a hydraulic line is always present in using a backhoe so the threat of an oil spill is more pronounced (control systems on cranes can be mechanical, pneumatic, or hydraulic). All of these factors need to be carefully analyzed before selecting equipment.

## HYDRAULIC

### General

Hydraulic dredges use a centrifugal pump which moves a slurry of water and material from the channel bottom through a piping system to a placement site. Hydraulic dredges are divided into four basic types:

cutterhead, dustpan, hopper, and sidecasting. Upper Mississippi River placement site requirements, the nature of the sediments to be dredged, and the 9-foot channel depth eliminate all but the cutterhead dredge from consideration.

#### Production Capability

1. Production - Before the production of a cutterhead hydraulic dredge can be estimated, a dredge size must be selected and the average length of pipeline must be determined. The dredge size depends mainly on availability, job duration, type of material, exposure to the elements, and capability to meet a specified minimum production requirement or construction period. In many instances, the production rate is the most uncertain part of the estimate. Because of its significance in regard to cost and time and because the range over which it can fluctuate can outweigh any other factor made in the estimate, the production rate is discussed in some detail. The most reliable approach for estimating a production rate is to base it on dredging records for the same or similar type work performed previously. If records are not available or applicable, a theoretical approach must be taken. The procedure for this approach is outlined in the following graphs and charts.

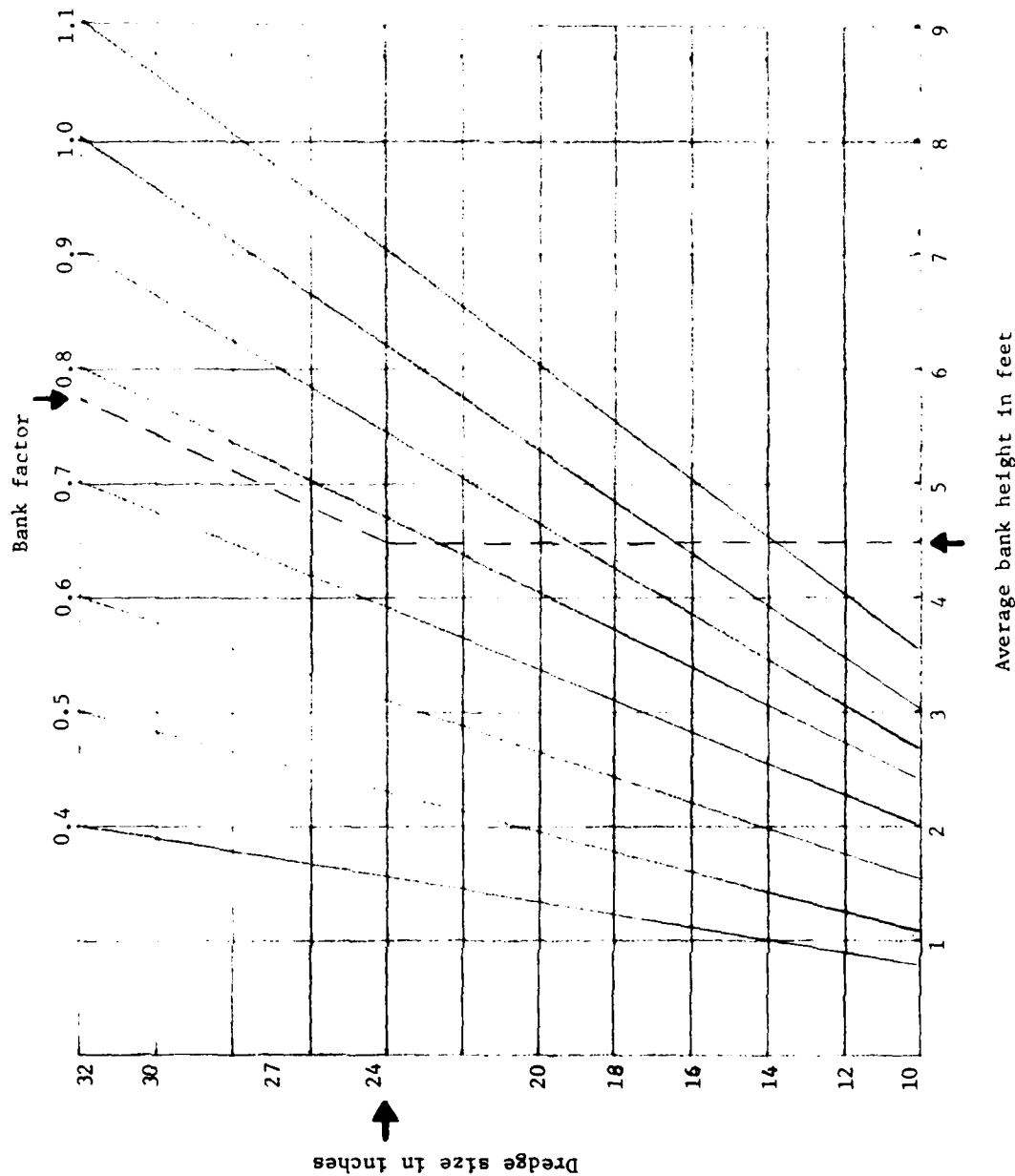
The following table lists the average production rate for each size dredge for two critical pipe lengths based on pumping free flowing sand having in situ density of about 2,000 grams per liter and a cutting depth (bank height) equal to the cutter diameter. The pipe length is the actual line length increased by "equivalent lengths" for fittings and rise of the discharge end of the piping above the waterline. These production figures must be modified by correction factors described in subsequent paragraphs.

Table B-3 - Hourly production as a function of line length

Dredge size	Average horsepower	Hourly production			
		Up to this length (feet)	Cubic yards per hour	At this length (feet)	Cubic yards per hour
10-inch	500	2,000	200	4,000	130
12-inch	800	2,500	270	5,000	180
14-inch	1,200	3,000	380	6,000	250
16-inch	1,500	3,500	500	7,000	330
18-inch	1,800	4,000	650	8,000	420
20-inch	2,400	4,000	800	8,000	520
24-inch	4,000	5,000	1,200	10,000	780
27-inch	5,500	5,500	1,500	11,000	980
30-inch	7,000	6,000	1,800	12,000	1,170
32-inch	8,000	6,000	2,100	12,000	1,370

The significance of the two pipe lengths for each size dredge is explained by the dredge's operation. The operation is controlled by two factors as the discharge line length increases. For short lines, the suction limitation holds the production rate constant. As the length increases, more power is used until the maximum power is reached. From then on, the power limits production. That is, longer lines reduce effluent velocity (assuming constant density). When the velocity slows enough, solids start to settle out. At this point, longer lines can only be used if booster pumps are added. The operation of a cutterhead dredge is characterized by two transitions - between suction and power and between power and velocity limit. The lengths at which these transitions are expected are given in the previous table together with the expected production rates. The dredging rate is the same for all line lengths less than the shortest one listed regardless of available pump power. Production between the two lengths listed can be interpolated.

Production in pipeline dredging is also controlled by the ability of the cutter to cut and the pump to transport the material and/or the speed with which the dredge advances over the dredging area. The latter is frequently the limiting factor in shallow banks of easily dredged material. The factors in the following figure are suggested to consider the effect of bank height. Factors are 1.0 where the bank height equals cutter diameter. Factors do not exceed 1.1 regardless of bank height.



Bank factor is 1.0  
where bank height  
equals cutter diameter.  
The factor is never  
greater than 1.1  
regardless of bank  
height.

Figure B-1 - Bank factor in pipeline dredging

The arrows and dotted line in the figure present an example of how bank height affects production. A 24-inch dredge dredging in a bank with an average height of 4.5 feet would have a bank factor of about 0.78.

The production rate can also be affected by the type of material dredged. Precise evaluation is difficult, particularly since bottom material is generally not of uniform consistency or density and precise data pertaining to it are usually lacking; however, the effect can be determined within an acceptable degree of accuracy. Because the hourly production rates in table B-3 are prepared for free-flowing sand having an in situ density of about 2,000 grams per liter, the production rates can be adjusted by factors to account for variations in the average in situ densities of different relatively free-flowing materials such as mud, silt, sand, or mixtures. The following figure gives the factor for different in situ densities. The chart is only for free-flowing materials and must not be used for fat or stiff clay, heavy gravel, cobbles, or broken stone. For the latter type materials, adjustments should be based on similar work.

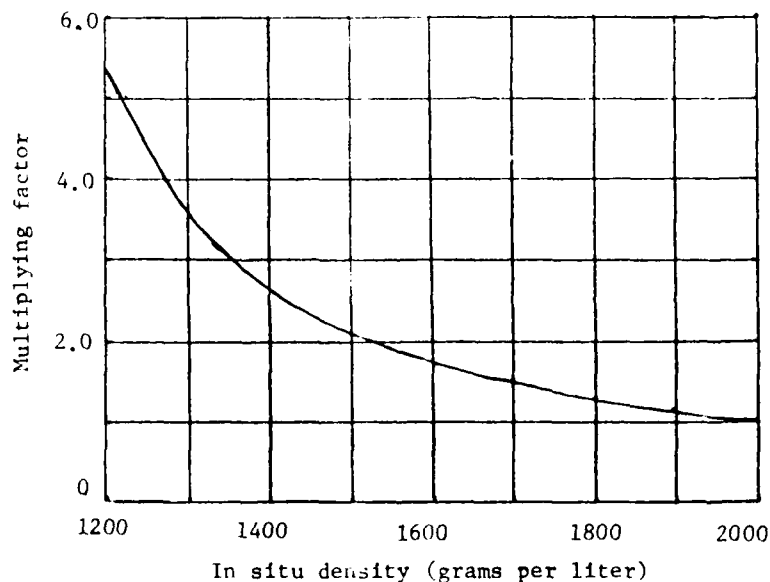


Figure B-2 - Multiplying factors for in situ densities



The operation of booster pumps presents several problems. These problems are normally more acute when starting a job and subside somewhat with experience. To account for the reduced production caused by the introduction of boosters, multiplication factors are used. These factors are assumed to be 0.8 for each booster pump used for jobs of up to 1-month duration and 0.9 for jobs that last longer.

Other correction factors (such as narrow channel (reduction), debris (reduction), ladder pump (15 to 30 percent increase)) may be necessary to estimate a production rate. These factors would be applied as required.

After all applicable factors are established, the product of the factors is multiplied by the chart production rate. The resulting figure is the net production or hourly dredging rate.

2. Time - Actual dredging times are less than 24 hours per day and 30 days per month. Pumping interruptions associated with dredging operations such as handling pipelines, handling anchor lines, clearing pump or cutter-head, changing location of plant on the job, passing vessels, repairing minor breakdowns, refueling, and waiting for attendant plant must be considered. A significant factor in the St. Paul District has been placement site setup and maintenance with related noneffective time. The number of daily operating hours (effective pumping time) must reflect these interruptions (exclusive of unfavorable weather).

The number of operating days per month is less than the number of days in the month because of holidays, inclement weather, exposure, major breakdowns, major moves, high river stages, and operating schedules less than 7 days per week. After the number of operating hours per day and number of operating days per month are established, they are multiplied with each other and the hourly net production to arrive at the monthly production.

3. Comparison of actual production and theoretical production -

The St. Paul District's experience with the 1,800-horsepower, 20-inch hydraulic dredge Wm. A. Thompson shows an 860-cubic-yard per hour production rate over a 5-year period. This production rate was developed from channel maintenance dredging on the Upper Mississippi. The average depth of cut (face) is 2.2 feet. Comparison of the Thompson's production with a 2.2-foot cut against a 20-inch dredge (4,000 feet of pipe) in table B-3 shows the actual production is greater than the estimate in the table. One reason is that the Thompson has a faster swing speed than dredges used for the bank factor chart data. Whenever available, individual dredge performance records should be used to estimate production rates to provide more reliable estimates. Excellent swing capability is very important to provide good production in shallow face dredging on the Mississippi River.

Suitability

The advantages of hydraulic dredging include:

1. The dredging operation is continuous.
2. The cutterhead sweeps the area without interruption and the material is pumped away.
3. The volume production capability exceeds any other dredging method.
4. The pipeline slurry transport system is the most flexible placement method available.
5. A pipeline can be floated across deep and shallow water with direct access to placement sites.
6. A pipeline can be laid across all types of land and has minimal impact on vegetation.
7. The transport system minimizes spillages because rehandling is not required.
8. Hydraulic dredging is labor effective.
9. Pipelines are less disruptive to communities than other forms of land transport.

The disadvantages of hydraulic dredging include:

1. The setup time is lengthy.
2. Placement site selection is limited by pipeline reach and pumping power.
3. The individual job size limits reasonable mobilization time and cost.
4. The volume of material transported to the placement site consists of 80 to 85 percent water and the water must be released with solids and potential pollutants resuspension.
5. To avoid encroachment beyond the placement site the slurry must be retained (a major cost consideration).
6. Small placement sites are not suitable for hydraulic placement.

#### COMPARISON OF MECHANICAL VERSUS HYDRAULIC DREDGING EQUIPMENT

##### General

Dredges are tools and, as such, work well within their designed capability. The mechanical dredge is an all-purpose tool to dredge various materials from sand to loose rock. Its mobilization time is minimal and therefore well suited for small dredging projects. Normal barging of dredged material allows great freedom of transport distances on a navigable system, but barge draft limits access. In comparison, a hydraulic dredge is a more specialized unit designed to dredge fine-grained material to sandy gravel. Setup of its pipeline system restricts efficient operation to larger dredging projects. The pipeline provides optimum access capability to adjacent placement sites. However, the slurry production requires larger placement sites. The high production capability allows quick response and excellent cost efficiency with suitable placement sites. However, long distance transport is prohibitive unless large quantities are available. The hydraulic dredge is better suited to sweep channels with small dredging faces.

Initial investment is significantly greater for hydraulic than mechanical dredging equipment, and a hydraulic dredge has less flexibility for multiple-purpose applications.

### Cost-Distance Relationship

As noted above, the distance from the dredge cut to the placement site is a critical factor in selecting dredging methods. The following figure illustrates the general relationship of unit costs for hydraulic and mechanical equipment as a function of distance from the dredge cut to the placement site, assuming the site is adjacent to the channel.

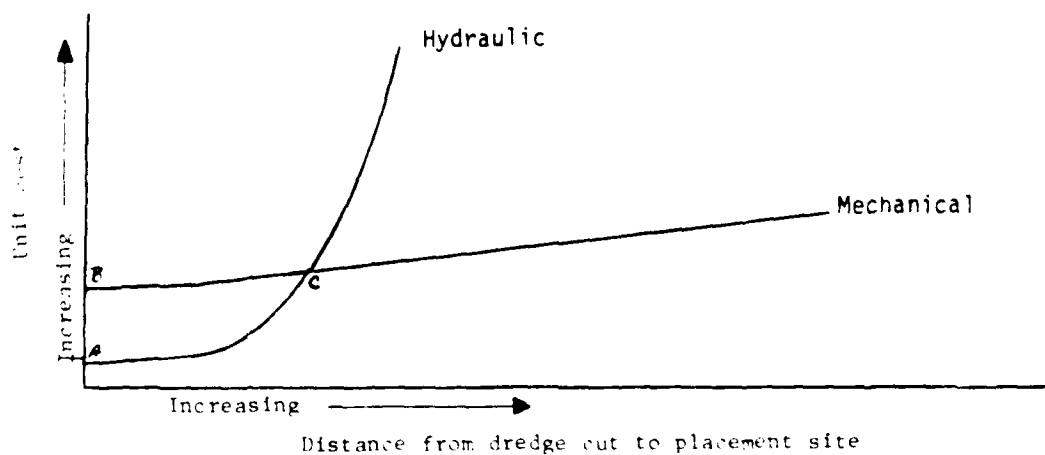


Figure B-3 - Relationship of cost to distance from dredge cut to placement site

The initial costs (points A and B) vary with the project size in distributing the mobilization and initial setup cost. Points A and B will be reversed on small dredging projects. The project size will also affect the intersection (point C). On extremely large projects, a hydraulic pumping distance of 15 miles has proven economically feasible. Once particular equipment, scope of the dredging job, and placement site have been identified, a project relationship can be developed.

### Placement and Rehandling Consideration

A placement site for material dredged mechanically must have enough capacity to store the material. Berming is not required unless the material is organic or silty. Equipment has to be used at the site to distribute

the material mechanically. Facilities must be available to allow barge unloading and transportation to the site or across the area. The barge unloading and material distribution are the most significant cost factors.

A placement site for material dredged hydraulically must have capacity to store the material and the slurry water for a sufficient period to allow settling of the material. The capacity varies with particle size and density. Under the worst condition (total retention required), the capacity would have to be five to six times the dredged material volume. Berming is generally required to prevent encroachment beyond the placement site. The site must be within reach of the pipeline from the dredging operation. However, access to the site and distribution of the material are generally very nominal considerations because flexible pipeline can reach the site and all areas within the placement site. Foundation conditions are not a concern except for construction of bermed facilities.

In summary, access and distribution of the barged material is the significant factor in mechanical dredging. In hydraulic dredging, the size and proximity of the placement site and berming requirements are significant. Using a hydraulic system to rehandle mechanically dredged material from barges gains advantages of both dredging systems.

#### DREDGING FLEET REQUIREMENTS

GREAT I has recommended equipment on a site-by-site basis without balancing total system requirements. GREAT I did not define specific rehandling sites or methods. Generally, GREAT I recommended that the Corps of Engineers develop rehandling methods and standards with the concerned State. Therefore, dredging requirements of the navigation system and a more detailed material placement site evaluation are required to determine the overall equipment needs.

#### RELATIONSHIP OF DREDGING EQUIPMENT AND PLACEMENT SITE SUITABILITY

Placement site suitability to hydraulic or mechanical dredging equipment was reviewed. Hydraulic handling of the dredged material at or to the placement site is required or the only reasonable method at the following sites:

1. Minnesota River - Peterson Bar, Cargill, and Savage - Material quality denies reasonable mechanical rehandling to inland site.
2. Site 3.34 - Railroad tracks must be crossed.
3. Site 2.34 - Lack of barge access and excessive trucking route. If method to rehandle 17,000 cubic yards of contaminated material cannot be devised, trucking will have to be investigated.
4. Site 2.02 - Mechanical rehandling of excessive volume is undesirable compared to direct hydraulic dredging.
5. Site 3.09 - No rehandling site provided. Economically and socially desirable to pump - 32,000 cubic yards.
6. Site 3.27 - Only known reasonable method of access - 25,000 cubic yards.
7. Site 4.24 - Only reasonable method - 89,000 cubic yards.
8. Site 5.26 - Only known access.
9. Site 5A.32 - Most reasonable method to avoid trucking 25,000 cubic yards annually and allow partial direct placement.
10. Site 6.17 - Only reasonable method of reaching park in Winona.
11. Site 8.22 - Only available access.
12. Site 9.03 - Only viable source without hauling through downtown Lansing.
13. Site 9.07 - Only viable access across railroad tracks.
14. Site 9.33 - Only viable access without hauling through park or private residences. Highly desirable.
15. Sites 10.01, 10.03, 10.04 - Only reasonable access. Lack of suitable access and handling sites.
16. Site 10.40 - No reasonable rehandling site or access.

The following table summarizes the distances and volume of dredged material at the GREAT I sites where hydraulic placement is desirable.

Table B-4 - Summary of hydraulic placement

Distance	Average annual volume of dredged material (cubic yards)
<u>From cut to placement site</u>	
Less than 5,000 feet	26,000
5,000-10,000 feet	89,000
2-3 miles	133,000
3-4 miles	22,000
4-6 miles	26,000
6-10 miles	9,000
Total	305,000
<u>From water to placement site</u>	
Less than 1,000 feet	162,000
1,000-2,000 feet	41,000
2,000-3,000 feet <sup>(1)</sup>	3,000
3,000-5,000 feet	99,000
Total	305,000

(1) Includes Chippewa River sediment trap.

At the other placement sites, mechanical rehandling is essential because of site characteristics or location. The following table summarizes mechanical placement.

Table B-5 - Summary of mechanical placement

Distance	Average annual volume of dredged material (cubic yards)
<u>From cut to placement site</u>	
Less than 5,000 feet	37,000
5,000-10,000 feet	46,000
2-3 miles	53,000
3-4 miles	11,000
4-6 miles	16,000
6-10 miles	19,000
Total	182,000
<u>From rehandling site to placement site</u>	
Less than 150 feet	153,000
150-300 feet	9,000
300-1,000 feet <sup>(1)</sup>	1,000
1,000 feet-4 miles	19,000
Total	182,000

(1) Almost all sites in this category are from 3 to 4 miles.

The characteristics of the placement sites which could be used effectively with either mechanical or hydraulic equipment are summarized in the following table.

Table B-6 - Summary of sites at which material could be placed with mechanical or hydraulic equipment

Distance	Average annual volume of dredged material (cubic yards)
<u>From cut to placement site</u>	
Less than 5,000 feet	92,000
5,000-10,000 feet	138,000
2-3 miles	75,000
3-4 miles	32,000
4-6 miles	46,000
6-8 miles	44,000
8-10 miles	14,000
Total	441,000
<u>Overland to placement site</u>	
Less than 150 feet	284,000
150-300 feet	50,000
300-500 feet	9,000
500-800 feet	15,000
800-1,000 feet	51,000
Over 1,000 feet	32,000
Total	441,000

#### SITES SUITABLE FOR HYDRAULIC DREDGING

Table B-7 was developed to illustrate Mississippi and St. Croix River dredge cuts and placement sites suitable for hydraulic dredging; table B-8 illustrates similar data for the Minnesota River. Table B-7 illustrates that 345,000 cubic yards (average annual) of material can be dredged hydraulically within 6,000 lineal feet over water plus up to 2,400 lineal feet overland except at site 4.24 where special overland distance would approach 6,000 feet. The Minnesota River (table B-8) was analyzed separately because only a small- or medium-sized dredge can operate on the narrow channel. Annually, 1,000 cubic yards could be dredged by



existing contractor hydraulic capability on the Minnesota River. The materials encountered on the upper portion of the Minnesota River are fine sand and silt. Rehandling of this material with mechanical equipment is extremely difficult and direct hydraulic dredging was selected. The balance of 568,000 cubic yards is well suited for mechanical dredging with barge transport because of the long haul distances. In some instances, the placement sites are suitable only for mechanical placement.

Table B-7 - Dredging and placement sites suitable for direct hydraulic placement, Mississippi and St. Croix Rivers

Cut	Placement site	Distance (feet)		Average annual volume of material dredged (cubic yards)
		Over water	Over-land	
St. C 1	SC 12	2,000	1,000	1,000
St. C 1	SC 13	2,000	1,000	1,000
St. C 2	SC 21	8,000	0	1,000
St. C 3	SC 1-6	4,000	500	
St. C 3	SC 22	4,000	500	10,000
St. C 3	SC 18	4,000	0	
St. C 3	SC 23	4,000	500	
2-2	2.35	6,000	1,500	6,000
2-3	2.35	6,000	1,500	11,000
2-7	2.14	6,000	2,000	
				48,000
	2.40T	2,000	800	
	2.02	4,000	2,000	
3-1	3.09	6,000	2,000	12,000
3-5	3.27	6,000	1,500	15,000
3-8	3.46	2,000	600	1,000
3-9	3.42	4,000	600	2,000
4-1	4.02	3,000	1,000	3,000
4-5	4.24	3,000	6,000	16,000
4-4 Chip.	4.24	5,500	6,000	73,000
4-8	4.57	6,000	1,300	2,000
4-10	4.63	2,000	900	5,000
5-2	5.30	2,000	500	8,000
5-3	5.30	2,000	500	13,000
5-4	5.30	4,000	500	17,000
5A-3	5A.32	4,000	900	12,000
5A-6	5A.23	2,000	600	1,000
6-2	6.17	6,000	1,200	2,000
6-3	6.17	4,000	1,200	11,000
6-4	6.17	6,000	1,200	4,000
8-4	8.30	6,000	800	26,000
8-5	8.30	6,000	800	17,000
9-3	9.26	6,000	200	9,000
9-6	9.11	6,000	600	9,000
	9.33	6,000	1,700	
10-3	10.01	4,000	600	3,000
10-7	10.40	4,000	2,400	4,000
10-09	10.16	4,000	600	2,000
Total				345,000

Table B-8 - Dredging sites suitable for hydraulic dredging,  
Minnesota River

Cut	Placement site	Distance (feet)		Average annual volume of material dredged (cubic yards)
		Over water	Overland	
MN-2				2,000
MN-3				10,000
MN-4				1,000
MN-5				2,000
Total				15,000

#### SITES SUITABLE FOR MECHANICAL DREDGING

Where dredging is done mechanically, the rehandling process required must be considered in detail to determine if the material would best be rehandled by mechanical or hydraulic methods.

#### Rehandling Considerations

Factors which must be considered in the selection of a rehandling method include:

1. Access to placement site
  - a. Identification of unloading site closest to placement area.
  - b. Dredging required to gain access to a rehandling site within a reasonable distance from the final placement site.
  - c. Feasibility of hydraulic barge unloading to minimize off-channel dredging or long distance indirect transport.
  - d. Impacts (social and environmental) of gaining access.
2. Rehandling distance
  - a. Equipment suited to transport material from unloading site to placement area limits.
  - b. Impacts of intermediate stockpiling.

3. Site conditions

- a. Vegetation - clearing required for alternative equipment.
- b. Site capacity.
- c. Drainage.
- d. Foundation condition - water level.
- e. Physical barriers such as streams, railroad embankments, or buildings.
- f. Adjacent features which could be affected by alternative methods of placement.
- g. Site preparation required for alternatives.

4. Impacts of alternative rehandling system on basic dredging operation

- a. Mobilization of rehandling system with mechanical dredges.
- b. Availability of rehandling equipment to support dredging.
- c. Preparation time for alternatives to gain access.
- d. Reliability of rehandling equipment.

5. Feasibility

- a. Cost-effective rehandling equipment.
- b. Existing equipment design.
- c. Availability in public or private sector.
- d. Public acceptance.
- e. Potential permit requirements.

This list is not complete but indicates multiple factors that must be considered. GREAT I was not able, because of time, funding, data, and agency differences, to develop a comprehensive barge unloading and re-handling plan for the CMP. Cost estimates were made without complete data, methodology, or system-oriented analysis and are of limited value without further refinement.

A brief discussion of the advantages and disadvantages of rehandling equipment options follows:

1. Mechanical unloading by backhoe or line crane

- Advantages - availability, proven capability, efficiency, very portable by barge without disassembly, low initial cost.
- Disadvantages - limited reach requires barge location adjacent to land and additional rehandling to reach final placement site.

2. Self-unloading barges

- Advantages - low manpower, self-contained for mobilization.
- Disadvantages - units are costly, multiple units would be required, feasibility questionable with saturated material, other disadvantages similar to those of a crane.

3. Front-end loader

- Advantages - transport reach increase, low initial cost, proven capability, portable.
- Disadvantages - small capacity, limited operation in dredged material and soft soil conditions, barge must be secured close to unloading site.

4. Belt conveyors

- Advantages - high production capability, low operating labor, potential reach capability.
- Disadvantages - belt conveyors pose greater mobilization effort, limited capability with saturated material, initial stockpiling, and subsequent rehandling.

5. Hydraulic dredge

- Advantages - efficient; high volume; proven capability; highly mobile; excellent accessibility across water, land, and any terrain; excellent reach.
- Disadvantages - slurry water in placement area, setup time for long distances without permanent lines, similar to direct hydraulic dredging limitations but smaller scope.

6. Dozers

- Advantages - availability, proven capability, efficient for short distances, portable.
- Disadvantages - high maintenance, limited reach, labor intensive, operation limited in wooded areas.

7. Scrapers

- Advantages - higher volume and range than dozer, proven capability.
- Disadvantages - initial cost, limited reach/volume capacity, mobilization, terrain limitations.

8. Truck

- Advantages - reach, availability, highly mobile.
- Disadvantages - limited capacity, limited operating terrain, cost.

### Trial Selection - Rehandling System

One large- or two medium-sized mechanical units can dredge 560,000 to 575,000 cubic yards per year. Two mechanical units would allow different rehandling units with each primary dredging unit.

Various rehandling units were reviewed and two were selected for further consideration at each placement site:

1. Mechanical unloading with a hydraulic backhoe or clamshell or conventional cable clamshell with two dozers. This method was considered where barge access to the placement area is readily available, placement area is of limited size, and the maximum transport distance is less than 200 feet. Trucks would be needed to supplement long hauls.

2. Small hydraulic dredge with smaller dozers. This method would be used where barge access is limited, transport distances are over 200 and less than 3,000 feet, access is poor, foundation is poor, the site is heavily wooded, and access through highway or railroad embankments is the most viable by pipeline.

### Application to GREAT I CMP

Tables B-9 and B-10 illustrate a logical allocation of rehandling methods for barge-transported material. Mechanical rehandling appears most viable for about 285,000 cubic yards. Hydraulic rehandling appears most viable for about 283,000 cubic yards. Two medium-sized units could handle these quantities. However, other factors must be evaluated and reviewed before implementation:

1. Hydraulic rehandling - Setup time must be minimized to allow full mechanical dredging capability. Permanent land pipelines should be evaluated at high-volume, more remote sites such as 5.26, 9.33, and 10.40. The quantity of permanent pipeline should be adjusted on the basis of experience.

Permanent culverts must be established through highway and railroad embankments. If States will not permit in-water rehandling, a direct pump-out system must be considered. Because material generally is not available at placement sites, berms to restrict encroachment should be built as an area is used.

2. Mechanical rehandling - Types of hydraulic or cable machines should be evaluated to determine optimum unit selections. Access should be surveyed and preparation anticipated (including clearing and dredging).

3. Barge characteristics - An optimum barge suitable to either rehandling method would have to be developed. Initial review indicates a barge capacity of 300 to 350 cubic yards would be desirable to reduce or limit quantity and tender requirements. Sizes larger than this would adversely affect barge draft or length which would adversely affect access or dredge advance, respectively, during dredging under heavier currents.



Table B-9 - Mechanical dredging with mechanical rehandling

Dredge cut	Placement site	Distance		Average annual volume (cubic yards)
		Over water	Overland	
MINN-1	2.18	6,000		3,000
St. C-1	SC 16	6 mi.	0	10,000
St. C-3	SC 24	6 mi	200	9,000
USAF-1	US 3	4,000	200	9,000
USAF-2	US 2	8,000	200	18,000
USAF-3	US 2	4,000	200	11,000
1-1	1.01	5 mi.	200	7,000
1-2	1.01	4.5 mi	200	2,000
1-3	1.01	4 mi	200	10,000
1-4	1.01	3 mi	200	14,000
1-5	1.01	2 mi	200	12,000
1-6	1.01	8,000	200	15,000
1-7	1.01	4,000	200	16,000
2-1	2.30	4,000	150	1,000
2-4	2.10	9.5 mi	1/4-2 mi	10,000
2-5	2.10	5 mi	1/4-2 mi	7,000
2-6	2.10	8,000	1/4-2 mi	2,000
2-7	2.13	2 mi	200	2,000
2-8	2.16	1 mi	200	5,000
2-9	2.37	8,000	200	9,000
2-10	2.18	4 mi	30	1,000
4-3	4.18	2.5	150	1,000
4-4	4.18	4,000	150	1,000
4-6	4.48-4.37	5 mi	4 mi	19,000
	4.48-4.38	5 mi	4 mi	
4-7	4.54	2 mi	350	3,000
5A-1	5A.25	3.5 mi	200	5,000
5A-2	5A.25	2 mi	200	3,000
5A-4	5A.25	2 mi	200	10,000
6-5	6.27	2,000	150	2,000
6-6	6.27	2.5 mi	150	3,000
7-1	7.20T	2,000	200	4,000
7-2	7.20T	3 mi	200	3,000
8-6	8.06	6.5 mi	200	35,000
8-7	8.06	5.0 mi	200	5,000
8-8	8.06	4.0 mi	200	3,000
8-9	8.06	2.0 mi	200	4,000
8-10	8.28	4,000	250	6,000
	8.06	4.0 mi	200	
9-1	9.47	6.0 mi	200	1,000
9-2	9.47	2,000	200	1,000
	9.26	4 mi	200	
9-3	9.47	5 mi	200	3,000
	9.03	2 mi	200 (city truck)	
Total				285,000

Table B-10 - Mechanical dredging with hydraulic rehandling<sup>(1)</sup>

Dredge cut	Placement site	Distance to rehandling	Distance from rehandling (ft)		Average annual volume (cubic yards)
			Over water	Overland	
3-2	3.09	2 mi	1,000	2,000	7,000
3-3	3.09	3 mi	1,000	2,000	11,000
3-4	3.27	4 mi	1,000	1,500	11,000
	3.09	6 mi	1,000	2,000	
	3.34	7.5 mi	1,000	1,800	
3-6	3.27	2 mi	1,000	1,500	4,000
	3.09	10 mi	1,000	2,000	
	3.34	2.5 mi	1,000	1,800	
3-7	3.34	2.0 mi	1,000	1,800	8,000
	3.46	3.0 mi	1,000	600	
4-2	4.02	3.7 mi	1,000	800	6,000
	4.20	3.0 mi	1,000	400	
4-3	4.02	4.0 mi	1,000	800	10,000
	4.20	2.5 mi	1,000	400	
4-4	4.25	2.5 mi	1,400	1,000	19,000
	4.20	5,000	1,000	400	
4-7	4.57	2 mi	1,000	1,300	
	4.49	2,000 ft.	1,000	400	7,000
	4.47	8,000 ft.	1,000	400	
4-9	4.57	2 mi	1,000	1,300	11,000
4-11	4.57	4.5 mi	1,000	1,300	2,000
5-1	5.30	2.5 mi	1,000	300	3,000
5-5	5.26	5.0 mi	1,000	3,000	10,000
5-6	5.26	4.0 mi	1,000	3,000	14,000
5-7	5.26	2.5 mi	1,000	3,000	9,000
5-8	5.26	2.0 mi	1,000	3,000	3,000
5A-1	5A.23	3.5 mi	1,000	900	6,000
5A-2	5A.32	2 mi	1,000	900	4,000
5A-5	5A.23	3.5 mi	1,000	600	18,000
6-1	6.17	2.0 mi	1,000	1,200	7,000
7-2	7.06	10 mi	1,000	1,000	6,000
	7.05	9 mi	1,000	600	
7-3	7.06	8 mi	1,000	1,000	9,000
7-4	7.06	6.5 mi	1,000	1,000	18,000
7-5	7.06	4.5 mi	1,000	1,000	2,000
7-6	7.05	8,000 ft.	1,000	600	16,000
7-7	7.06	2,000 ft.	1,000	1,000	2,000
8-1	8.22	1 mi	3,000	800	1,000
8-2	8.22	3,000 ft.	3,000	800	1,000
8-3	8.30	2 mi	1,000	800	6,000
9-4	9.07	2 mi	1,000	1,800	13,000
9-5	9.07	8,000 ft.	1,000	1,800	3,000

Table B-10 - Mechanical dredging with hydraulic rehandling <sup>(1)</sup> (cont.)

Dredge cut	Placement site	Distance to rehandling	Distance from rehandling (ft)		Average annual volume (cubic Yards)
			Over water	Overland	
9-7	9.15	2.5 mi	3,000	500	1,000
	9.17	4.0 mi	1,000	600	
	9.33	4.0 mi	1,000	1,700	
9-8	9.15	2.0 mi	3,000	500	9,000
	9.17	5.0 mi	1,000	600	
	9.33	5.0 mi	1,000	1,700	
9-9	9.15	6,000 ft	3,000	500	8,000
	9.17	6.5 mi	1,000	600	
	9.33	19 mi	1,000	1,700	
9-10	9.15	6,000	3,000	500	2,000
	9.17	7 mi	1,000	600	
	9.33	7 mi	1,000	1,700	
10-1	10.02/10.04	3 mi	3,000	600/3.5 mi	1,000
	10.02/10.04	3 mi	3,000	600/3.5 mi	
10-2	10.04	4,000 ft	3,000	600	5,000
10-4	10.01	8,000	1,000	600	1,000
10-5	10.41	8,000	1,000	500	2,000
10-8	10.40	2 mi	1,000	2,400	12,000
10-09					5,000
10-10	10.40	4 mi	1,000	2,400	1,000
	10.17	4,000 ft	1,000	400	
	10.40	5 mi	1,000	2,400	
Total					283,000

(1) Basic requirement is 3,000 feet over water, only 11,000 yards required over 1,500 feet. Two sites require over 2,000 feet of shore pipe. These two should have permanent pipe. Additional permanent pipe can be considered if required for efficiency.

## EQUIPMENT SELECTION FOR THE CMP

On the basis of the preceding discussion and analysis, the following equipment mix appears suitable and feasible to implement the CMP.

1. A large hydraulic dredge with 6,000 feet effective pontoon line reach and 2,000 feet of shore pipe. Pump capacity should anticipate a lift of 30 feet. This unit would dredge under emergency conditions and volumes beyond the mechanical dredging capacity. Temporary placement sites would be used when direct access to GREAT I sites was unavailable.
2. Two basic mechanical dredging units consisting of hydraulic hoe or clamshell or conventional cable crane clamshell. Each unit is capable of producing 350,000 to 400,000 cubic yards in a 5-month period. Adequate barge and tender capability would be needed to transport the dredged material over the water distance.
3. One hydraulic hoe or clamshell or cable crane clamshell with dozers for rehandling at the placement site.
4. One hydraulic rehandling dredge, possibly a direct pump-out unit with an effective reach of 3,000 feet over water and 2,000 feet overland. Pump capacity should anticipate a lift of 30 feet.
5. Additional auxiliary equipment to complete three packages.

Although the equipment package described above is believed to be capable of implementing the CMP, further economic and alternative evaluations are required. The Clean Water Act, Sections 402 and 404(t), could significantly affect the rehandling methods and placement site requirements. This equipment package would minimize the physical impacts without water quality provisions when dredging uncontaminated sediment. If regulations require substantial retention time with uncontaminated sediments, cost relationship of hydraulic to mechanical dredging and rehandling would change significantly.

An economic evaluation of direct hydraulic versus mechanical dredging with rehandling at varying distances is required. Rehandling techniques considering volume, distance, and access should be reviewed further. Each placement site should be field surveyed to ensure that access is realistic and compatible with the tentative equipment application. These evaluations and regulatory clarifications must be made before a long-term equipment determination or a commitment to fully implement the CMP can be realized.

APPENDIX C

DREDGING REQUIREMENTS FOR THE 9-FOOT  
NAVIGATION CHANNEL

UPPER MISSISSIPPI RIVER AREA  
(HEAD OF NAVIGATION TO GUTTENBERG, IOWA)

ST. PAUL DISTRICT  
U. S. ARMY CORPS OF ENGINEERS  
JUNE 1981

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## APPENDIX C

### DREDGING REQUIREMENTS FOR THE 9-FOOT NAVIGATION CHANNEL

#### INTRODUCTION

This appendix summarizes some of the important variables that affect the dredging requirements of the 9-foot navigation channel. More details on these and other variables are in the Dredging Requirements and Channel Maintenance Appendixes of the GREAT I report and the 1974 environmental impact statement (EIS) on the operation and maintenance of the channel.

#### HISTORIC DREDGING VOLUMES

Maintenance dredging of the 9-foot channel in the GREAT I reach of the Upper Mississippi River started in 1937. Several factors are pertinent in the selection of a period of the dredging records that would be representative of the channel maintenance dredging requirements:

1. From 1937 through 1945, pools 1 through 10 and the St. Croix River were heavily dredged. In 5 of the years, the volume dredged exceeded 3 million cubic yards. In 1937 and 1938, the volumes exceeded 4 million cubic yards. Much of this dredging was done to provide the authorized depth and width of the channel.
2. Upper and Lower St. Anthony Falls pools and the Minnesota River were added to the system in 1964 and 1967, respectively.
3. Before 1974, maintenance dredging was generally done to a depth of 13 feet below the low pool level.
4. Volumes were very low from 1975 through 1979 as a result of several factors including low flows and reduced-depth dredging.
5. Large floods occurred in 1952, 1965, and 1969.



6. From 1950 through 1979, the Chippewa River contributed its largest volumes of sediment in 1951, 1954, 1968, and 1973.

7. Although summary data on volumes extend back to 1937, more detailed data are available only back to 1956.

8. Starting in 1956, the Dredge Thompson was scheduled for dredging outside the St. Paul District on a regular annual basis, shortening the period when it was available for use in the District.

The base period selected by GREAT I was the 20-year period 1955 through 1974. Eight other periods were analyzed to see how representative the sample period was. Table C-1 presents a summary of the sensitivity analysis for dredging volumes for separable reaches of the GREAT I area.

Table C-1 - Summary of sensitivity analysis of GREAT I base period historic dredging volumes in GREAT I area, Upper Mississippi River

Reach of River	Average Annual Dredging Volumes in 1000 Cubic Yards										DIFFERENCE BETWEEN		REMARKS ON SELECTED PERIOD
	1950-72	1950-74	1950-77	1950-79	1956-72	1956-74	1956-77	1956-79	HIGH AVERAGE	MEDIAN AVERAGE	LOW AVERAGE	GREAT I AVERAGE 1955-74	
St. Croix	38.0	42.2	37.7	35.9	42.6	47.8	41.3	38.7	47.8	41.3	35.9	45.5	9% - May be high
MN River	26.7 (1)	27.9 (1)	20.3 (1)	17.2 (1)	26.7 (1)	27.9 (1)	20.3 (1)	17.2 (1)	27.9	26.7	17.2	27.5	3% - May be high; long record is lower.
Upper & Lower St. Anthony Falls	43.4 (2)	52.7 (2)	55.1 (2)	53.8 (2)	43.4 (2)	52.7 (2)	55.1 (2)	53.8 (2)	55.1	52.7	43.4	50.7	4% - May be low.
Pool 1	140.4	133.2	124.9	121.4	118.0	110.8	103.4	100.8	140.4	118.0	100.8	107.5	10% - May be low.
Pool 2	152.8	183.6	172.6	166.9	142.7	184.4	170.2	163.3	184.4	166.9	142.7	153.1	9% - May be low.
Pool 3	115.8	114.5	102.2	95.4	109.2	108.1	93.4	85.6	115.8	102.2	85.6	101.3	1% -
Pool 4 (total)	(290.3)	(283.8)	(265.1)	(266.6)	(293.7)	(284.7)	(260.8)	(263.0)	(294.6) <sup>(3)</sup>	(283.4) <sup>(3)</sup>	(255.9) <sup>(3)</sup>	(290.4)	-
-Above Lake Pepin	72.1	66.7	60.8	56.8	75.4	68.0	60.2	55.3	75.4	66.7	55.3	71.2	6% -
-Below Lake Pepin	218.2	217.1	204.4	209.8	218.3	216.7	200.6	207.6	219.2	216.7	200.6	219.2	1% -
Pool 5	182.5	178.9	164.1	159.6	162.2	159.7	143.5	139.5	182.5	162.2	139.5	162.5	-
Pool 5A	113.7	105.8	97.3	93.0	97.9	89.2	80.6	76.6	113.7	93.0	76.6	86.2	8% - May be low.
Pool 6	55.0	53.3	49.3	46.0	46.9	45.6	41.6	38.2	55.0	46.0	38.2	41.8	10% - May be low.
Pool 7	125.7	119.2	109.6	103.7	94.5	89.2	81.2	76.2	125.7	95.5	76.2	95.5	-
Pool 8	172.5	172.0	156.4	146.4	154.3	155.6	138.0	127.0	172.5	154.3	127.0	152.0	2% -
Pool 9	118.8	121.1	108.5	103.3	114.9	118.3	102.6	96.7	121.1	114.9	96.7	120.5	5% -
Pool 10	71.1	68.2	66.9	63.6	78.2	73.6	71.2	66.8	78.2	70.0	63.6	70.0	-
TOTAL	1646.7	1656.4	1530.1	1472.8	1525.2	1547.6	1403.2	1343.3	1714.7 <sup>(4)</sup>	1527.1 <sup>(4)</sup>	1299.3 <sup>(4)</sup>	1504.5	2% -
NUMBER OF YEARS IN PERIOD	23	25	28	30	17	19	22	24	-	-	-	20	-

(1) Period of record starts in 1967.

(2) Period of record starts in 1964.

(3) Sum of the averages for above and below Lake Pepin.

(4) Sum of the averages by reach.

Following are some conclusions regarding the sensitivity analysis of the selected base period:

1. On an individual pool basis, the average volume of material dredged is considerably affected by the period of record chosen. The selected period can make an even greater difference on an individual cut basis. In pools 1, 2, 5A, and 6, the selected volumes for the pools appear low. On the Minnesota and St. Croix Rivers, the selected volumes appear high.
2. The average annual volume dredged in the District (about 1.5 million cubic yards) appears representative of the historic record.
3. The volumes dredged at any individual cut, when based on the average volume over a period of years, should be used with caution. These volumes can be affected significantly by site-specific actions that may not be identified in the records. Average annual volumes at specific sites should be used recognizing that volumes may vary significantly and that any placement site selected should be capable of handling volumes higher than the average annual estimates.

#### TRIBUTARY SEDIMENT SUPPLY

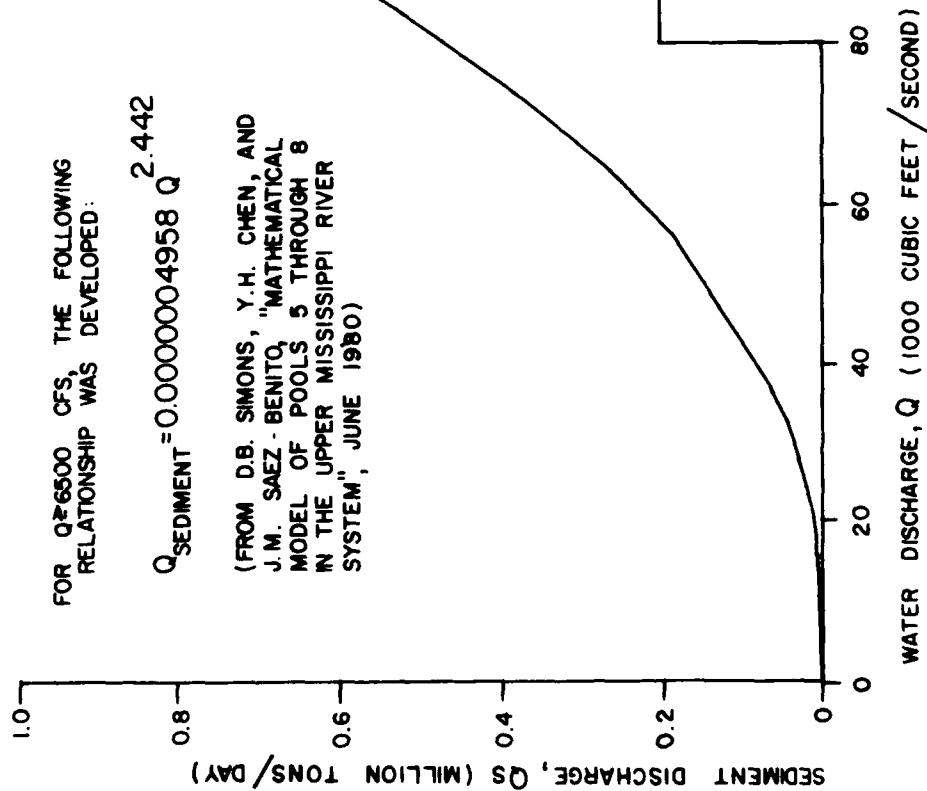
Tributaries carry both fine and bed load sediment into the Mississippi River. These sediments affect the navigation channel and backwater areas. Bed load sediment is of principal concern in channel maintenance.

Of the nine major tributaries in the GREAT I reach of the 9-foot channel, the Chippewa River is the largest contributor of bed load sediment. The relationship of bed load sediment and water discharge for the lower Chippewa River as it enters the Mississippi River is illustrated in Figure C-1. As the figure shows, the discharge of bed load sediment increases exponentially with respect to the water discharge. (For a water flow of 40,000 cfs (cubic feet per second) the bed load sediment flow is about 100,000 tons per day. With a water flow of 80,000 cfs, the bed load

sediment flow is about 400,000 tons per day.) Thus, the greatest volume of bed load sediment is being moved to the delta of the Chippewa River and the Mississippi River during major floods on the Chippewa River. Simons and Chen<sup>(1)</sup> estimated that the average annual amount of bed load sediment reaching the Mississippi River from the Chippewa River is 450,000 cubic yards per year (610,000 tons per year).

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(1) Simons, Chen, et al., "Investigation of Effects of Chippewa River Erosion and Silt Reduction Measures," Colorado State University, Fort Collins, Colorado. September 1980.



GREAT I STUDY  
ST. PAUL DISTRICT IMPLEMENTATION REPORT  
UPPER MISSISSIPPI RIVER

BEDLOAD SEDIMENT AND WATER  
DISCHARGE RELATIONSHIP  
LOWER CHIPPEWA RIVER

U.S. ARMY. CORPS OF ENGINEERS  
FIGURE C-1

This average annual sediment load is based on the average yearly flow at 2-year recurrence intervals. The estimate of an average annual sediment bed load reaching the Mississippi River from the Chippewa River ranges from 540,000 to 450,000 cubic yards per year. The higher figure is obtained by using projected 1990 conditions, the lower figure by using projected 2040 conditions. The average from 1950 through 1979 was 550,000 cubic yards per year using historic water flow data and the Simons and Chen water discharge and bed load sediment flow relationships. Thus, the estimates indicate that more than 450,000 cubic yards of bed load sediment come from the Chippewa River annually. The average annual dredging quantities in lower pool 4 are about 219,000 cubic yards. Slightly less than half of the bed load sediment entering lower pool 4 must be dredged as it passes through the lower pool to ensure a navigable 9-foot channel.

Colorado State University investigated several alternatives to reduce the dredging requirements in lower pool 4 through tributary bed load sediment control on the Chippewa River. Table C-2 summarizes the estimated effectiveness of the major alternatives. Most of the sediment traps and low-head dams would reduce dredging requirements by at least 50 percent. However, with the sediment traps, the total dredging requirements are greater because the material is dredged before it enters the main channel of the Mississippi River. The total dredging requirements of the low-head dams are less than the without dams condition because the dams keep the bed load sediment in the Chippewa River and cause aggradation of the bed in the reach of the river just upstream of the dam. Eventually, dredging must be done behind the dams to maintain the dams' sediment trapping efficiency. However, the volumes dredged would be less than those with the sediment traps.

The benefits of reducing the bed load sediment reaching the Mississippi River are estimated to extend downstream only as far as river mile 757 in lower pool 4.

Estimated dredging quantities in lower pool 4 in the Upper Mississippi River from 1990 (1) 2040 and various alternatives used for tributary bed load sediment control on the Chippewa River

	Volume dredged for channel maintenance (1,000 cu yds)	Percent reduction from base condition	Volume to be dredged at sediment trap (2) or tributary (1,000 cu yds)		Percent change in total volume
			Average for annual	Average annual	
confinement (without future)				1,650	173
No. 1 - bank protection plus 17,000-cubic-yard per year sediment trap	3,550	50	5,000	9,380	88
No. 1b - bank protection plus 233,000-cubic-yard per year sediment trap	1,060	82	11,650	264	453
No. 2a - 6-foot low-head dam plus bank protection	5,580	35	1,200	6,780	136
No. 2b - 10-foot low-head dam plus bank protection	4,260	51	5,600	114	-34
No. 3a - 6-foot low-head dam plus dredging upstream of dam		47	1,250	5,800	12
No. 3b - 10-foot low-head dam plus dredging upstream of dam	2,980	66	1,300	4,520	-48
No. 4 - Sediment trap at mouth of Chippewa River at 117,000 cubic yards per year			3	9,700	412

(1) Summarized from Sfriso, Chen, et al., "Investigative Measure," Colorado State University, Fort Collins, 1989. Total volumes estimated to be dredged from 1990 through 2040.

Chippewa River Erosion and Siltation 1989

Colorado State University's economic analysis showed that the largest and most readily quantifiable benefit of these alternatives was savings in dredging costs. The evaluation showed the low-head dams would be economically feasible and the 10-foot low-head dam would be the most economically feasible. The sediment traps would not be cost effective. However, in the evaluation, per cubic yard dredging costs for the sediment traps were estimated as being higher than the unit costs for dredging in the navigation channel. Under certain conditions, the unit costs of dredging a sediment trap near the mouth of the Chippewa River could be less than those for navigation channel dredging, in which case sediment traps would be cost effective. Further evaluations are needed to determine which method would be most cost effective and environmentally and socially acceptable and if appropriate State permits would be issued for the apparent best plans.

#### WIDTH AT BENDS

The width of the navigation channel can significantly affect the volume of material dredged. The width at bends is of particular concern to navigational interests because bends are often difficult to negotiate under adverse weather and river conditions. Extra channel width is highly desired, especially by less experienced towboat operators. Variables affecting the width of channel required for safe navigation at a bend include radius of river bend, length of tow, shape of tow, location of the center of mass of the tow, tow velocity, river velocity, width of tow, draft of tow, depth of channel, total river surface width, angle of current velocity to tow longitudinal direction, and operator proficiency. Channel widths at bends have been maintained up to 550 feet, and overwidth or advance dredging was done as equipment and funds allowed. Different interests may not agree on whether to increase or decrease channel widths at bends, so any proposed changes should consider the potential environmental impacts, dredging costs, and navigation safety.

Table C-3 lists the dredge cut locations at bends in the GREAT I area which were listed as candidates for potential width changes.



Table C-3 - Dredge cut locations at river bends which are considered potential candidates for changes in the width of the channel maintained at the bend, Upper Mississippi River, GREAT I area(1)

Pool	Cut	Cut name	River mile	Bend name	River mile	Potential width change (feet)
2	5	Grey Cloud Slough	827.5 - 828.3	Grey Cloud Slough	827.3 - 828.0	+50
2	3	Boulanger Bend	820.8 - 821.4	Boulanger Bend	820.3 - 821.5	+50
2	2	Boulanger Bend Lower Light	819.0 - 819.8	Boulanger Bend Lower Light	818.4 - 820.3	-50
3	5	Four Mile Island Truesdale Slough	807.0 - 808.6	Truesdale Slough	808.2 - 808.8	+50
3	5	Four Mile Island Truesdale Slough	807.0 - 808.6	Four Mile Island	807.2 - 807.8	+50
3	1	Below Diamond Bluff	798.9 - 800.5	Below Wind Creek	800.0 - 800.7	-50
4	6	Wacouta Point	783.3 - 785.5	Head of Lake Pepin	785.2 - 785.6	+50
4	5	Reads Landing	761.8 - 763.8	Below Reads Landing	761.5 - 762.5	+50
4	5	Reads Landing	761.8 - 763.8	Reads Landing	762.4 - 763.3	+50
4	4	Above Crats Island	758.5 - 759.5	Crats Island	758.0 - 759.5	-50
5	7	Mule Bend	748.6 - 749.6	Mule Bend	747.8 - 748.8	+50
5	5	Below West Newton	746.0 - 746.8	Below West Newton	746.4 - 746.9	-50
5A	3	Head of Betsy Slough	731.0 - 732.2	Betsy Slough Bend	731.0 - 731.7	+50
7	4	Winters Landing	707.9 - 709.3	Winters Landing	708.0 - 709.0	-100
8	9	Sand Slough	694.3 - 695.0	Sand Slough	694.4 - 695.2	-100
8	6	Above Brownsville	689.9 - 690.8	Brownsville	689.7 - 690.2	-50
9	9	Island 126	677.4 - 678.3	Island 126	677.2 - 678.2	-50
9	3	Lansing Upper Light	663.8 - 665.0	Lansing Upper Light	663.8 - 665.0	-100
9	2	Above Atchafalaya	660.3 - 660.8	Below Lansing	660.3 - 661.0	-100
10	9	Hay Point	646.0 - 646.6	Gordons Bay	645.4 - 646.1	-50
10	7	Mississippi Gardens	642.7 - 643.3	Mississippi Gardens	642.5 - 643.5	-50
10	4	Wyalusing Bend	628.9 - 629.3	Wyalusing Bend	628.6 - 629.3	-100
10	3	Wyalusing	627.3 - 628.0	Wyalusing	627.2 - 628.0	-100
10	1	Upper Approach L/D 10	615.1 - 616.0	Ferry Slough	615.6 - 616.3	-150

(1) Broken Arrow Bend (river mile 675.8) and Bad Axe Bend (river mile 674.0-675.0) were identified as having potential for reduction in width; however, these bends have not been dredged since 1944 and 1937, respectively. Dredging is not projected at these bends and they are not listed in the display.

## APPROACHES TO STRUCTURES

At certain locations, a vessel's ability to maneuver is extremely important to the safety of the vessel and crew. The most critical locations are approaches to rigid structures such as bridges and locks. The ability of a towboat with barges to maneuver is reduced as the water depth becomes shallower. At 28 dredge cuts (see table C-4), where safety of navigation is a key consideration, the dredging depths would be determined on the basis of safety factors.

Table C-4 - Dredge cut locations at approaches to rigid structures where navigational safety would be a key consideration in determining need for dredging, Upper Mississippi River, GREAT I area

Pool	Cut No.	Name
USAF	1	Above and below Broadway and Plymouth Avenue Bridge
	2	Above and below Lowry Avenue Bridge
	3	Below Minneapolis, St. Paul, and Sault Ste. Marie Railroad bridge
1	1	Upper approach to locks and dam 1
	4	Above Lake Street Bridge
	6	Above Franklin Avenue Bridge
	7	Below Lower St. Anthony Falls lock and dam
2	1	Above locks and dam 2
	8	St. Paul-Harriet Island
	9	Above and below Smith Avenue Bridge
	10	Lower approach to locks and dam 1
3	9	Lower approach to locks and dam 2
5	8	Lower approach to lock and dam 4
5A	1	Upper approach to lock and dam 5A
	6	Lower approach to lock and dam 5
6	3	Below Winona railroad bridge
	4	Above Winona railroad bridge
	5	Island 71
	6	Lower approach to lock and dam 5A
7	1	Upper approach to lock and dam 7
	7	Lower approach to lock and dam 6
8	10	Above and below La Crosse railroad bridge
9	10	Lower approach to lock and dam 8
10	1	Upper approach to lock and dam 10
	6	East Channel
	10	Lower approach to lock and dam 9
Minn.	5	Savage Bridge
St. Croix	3	Hudson

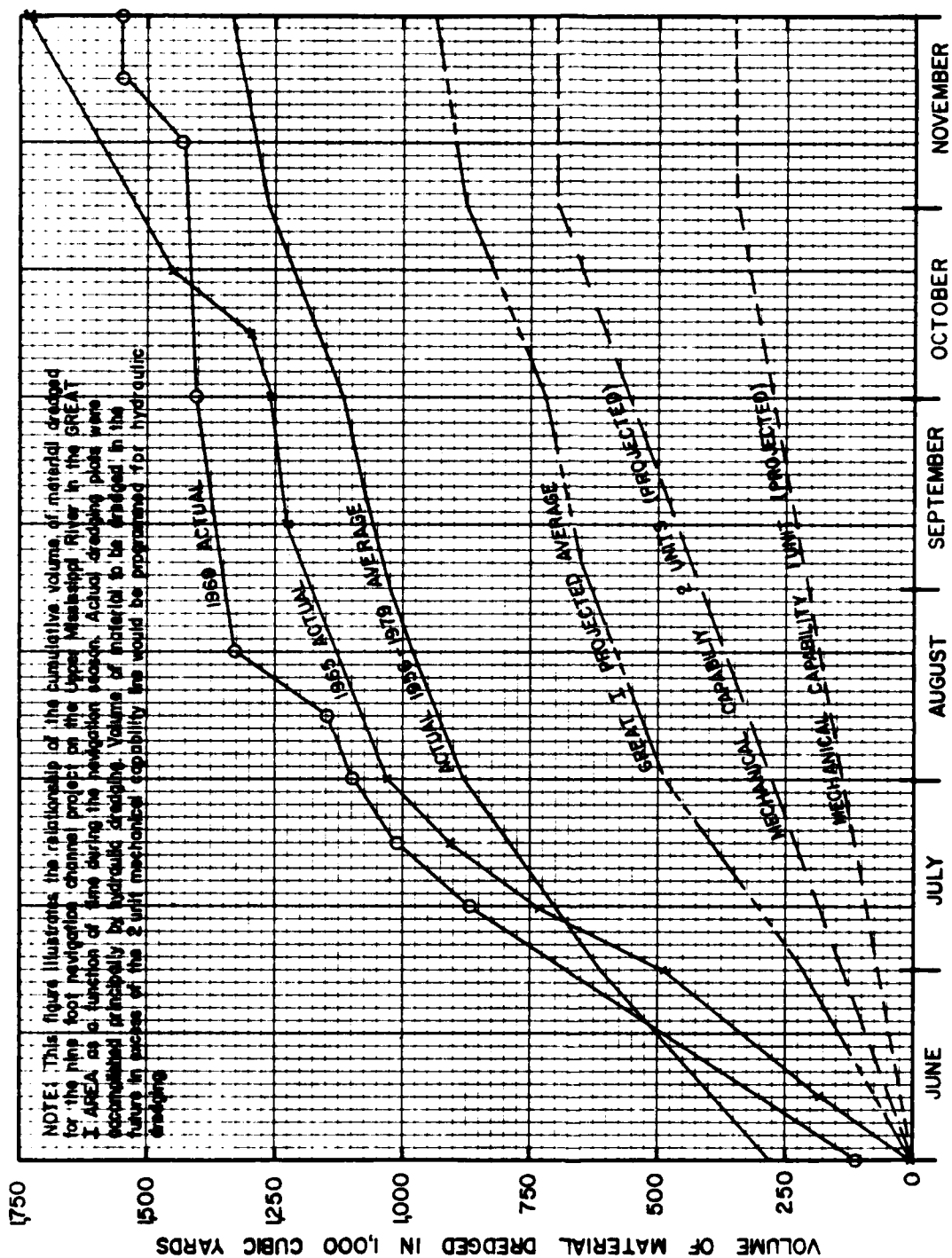
## RELATIONSHIP OF DREDGING TO EQUIPMENT NEEDS

The GREAT Channel Maintenance Plan (CMP) projects a frequency of dredging and an average dredging quantity at each historic dredging location. Volume projections are based on the averages of historic dredging requirements that have been reduced as a result of factors discussed in Volume 1 of the CMP. Projected average annual quantities for each site are computed from the frequency and average job size. The sum of these provides the average annual dredging quantity for the District.

The CMP does not attempt to project annual quantities for extreme years when dredging requirements are substantially higher or lower than the average. Time constraints within which dredging must be accomplished during the season are also not considered. Years of lower requirements are not a concern because an equipment package adequate for an average year can handle the lower volumes. Higher than average annual quantities, however, must be considered when recommending a placement site plan and assembling an equipment package. GREAT recognized this need in Action Item 8, which designates temporary or emergency placement sites closer to the higher frequency dredging locations.

Records show that annual requirements can vary considerably because of hydrologic conditions. In addition, response time is regulated by site conditions and water level fluctuations. These factors limit the time frame available to perform the required dredging.

Figure C-2 compares the time relationship with dredging quantities in an average year (1956-1979 period of record) and in flood years (1965 and 1969). In 1969, 85 percent of the season's dredging was accomplished by 20 August, the approximate midpoint. In 1965, 65 percent was completed by the middle of the season. In an average season, 73 percent of the dredging has been done by that date.



GREAT I STUDY  
ST. PAUL DISTRICT IMPLEMENTATION REPORT  
UPPER MISSISSIPPI RIVER  
CUMULATIVE SUMMARY OF VOLUMES  
DREDGED DURING NAVIGATION SEASON  
U.S. ARMY CORPS OF ENGINEERS

The projected average annual volume (928,000 cubic yards) has been plotted on Figure C-2 parallel to the historic average annual amount. Appendix B addresses equipment requirements to implement the CMP. Two medium size mechanical dredging fleets, each with a 350,000- to 400,000-cubic yard-per-season capacity, and a larger capacity hydraulic dredge to handle the remaining quantity would be able to implement the volumes identified in the CMP. Capability of the two mechanical units is illustrated as a straight-line production from the beginning of the season until 1 November. Additional requirements are designated for a large hydraulic dredge. Nearly 75 percent of the hydraulic dredge's seasonal requirements occur before 1 August. The 928,000 cubic yards includes approximately 73,000 cubic yards dredged at the mouth of the Chippewa River at a sediment trap. If effective, this quantity can be routinely scheduled and would not be subject to the time constraints of normal channel maintenance.

The capability of the two mechanical units is relatively fixed at 700,000 to 800,000 cubic yards per year. Therefore, the hydraulic unit must be able to accommodate increased volumes during years of high dredging requirements and within the limited time frame. In years such as 1965 and 1969, the capability needed is 320,000 and 400,000 cubic yards per month. Although channel maintenance practices have changed substantially in an effort to reduce overall volumes, conditions in 1965 and 1969 necessitated reduced-depth dredging with minimal width to be able to respond to multiple requirements. During a season similar to an average year, over 250,000 cubic yards per month capability is needed for the hydraulic dredge.

The historical average (1956-1979) and 1965 and 1969 actual dredging records indicate a large percentage of the dredging was done early in the season (by 1 September or earlier). One reason is the scheduling of the Dredge Thompson to work in the Rock Island District. Thus, some of the potential high shortages indicated in June, July, and August on the average basis may not be of critical concern; however, during peak flood years this factor will be a major concern.

APPENDIX D

ENVIRONMENTAL ANALYSIS OF  
IMPLEMENTATION OF GREAT I RECOMMENDATIONS  
FOR THE 9-FOOT NAVIGATION CHANNEL

UPPER MISSISSIPPI RIVER AREA  
(HEAD OF NAVIGATION TO GUTTENBERG, IOWA)

ST. PAUL DISTRICT  
U.S. ARMY CORPS OF ENGINEERS

JUNE 1981

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APPENDIX D  
ENVIRONMENTAL ANALYSIS OF IMPLEMENTATION  
OF GREAT I RECOMMENDATIONS FOR THE  
9-FOOT NAVIGATION CHANNEL

INTRODUCTION

This report outlines three programs for implementation of GREAT I recommendations. These programs are discussed in detail in Appendix A. A brief summary follows:

1. Basic Program - The Corps would continue to operate and maintain the 9-foot navigation channel and comply with and incorporate as many of the GREAT I recommendations as current funding levels and scheduling will allow.
2. First Priority Program - The Corps would implement the higher priority GREAT I recommendations if they are justified and necessary funds are received.
3. Early Implementation of GREAT I Program (GREAT I) - The Corps would implement all GREAT I recommendations.

This appendix summarizes the impacts of the three programs on the major resources and users of the river and highlights significant differences in impacts between the programs.

This appendix concerns itself only with Corps of Engineers involvement in implementing the GREAT I recommendations. If implementation of a given recommendation would have significant impacts but the Corps would have little or no involvement in its implementation (for example, Action Item 12 - upland erosion control), the impacts of implementation are discussed only briefly, if at all.

## ENVIRONMENTAL DOCUMENTATION

The Corps of Engineers is required to prepare environmental impact documents (assessments or statements) on the operation and maintenance (O&M) of the 9-foot navigation channel. These documents are required by the National Environmental Policy Act of 1969 (NEPA) and regulations for implementation of NEPA promulgated by the Council on Environmental Quality (CEQ, 1969) and the Corps of Engineers (33 CFR 230). This report is not a NEPA document.

A final environmental impact statement (EIS) is on file for the 9-foot navigation channel (filed in November 1973). A final EIS has been prepared for the OKAI-1 study and will be filed with the Environmental Protection Agency in the near future.

Future requirements for NEPA documentation are straightforward. If the impacts of an O&M activity or implementation of a GREAL-1 recommendation are adequately addressed in an existing NEPA document such as the 9-foot navigation channel or the GREAL-1 EIS (once it is on file with the Environmental Protection Agency), no further NEPA document will need to be prepared.

If a proposed action is not adequately addressed in an existing NEPA document and the action would have significant impacts, the St. Paul District will prepare a supplement to one of the existing EIS's. If the action would have no significant impacts, a separate assessment and finding of no significant impact will be prepared. The majority of these actions do not appear to warrant a separate EIS.

## ENVIRONMENTAL ANALYSIS

Table D-1 summarizes the relative magnitude of the impacts of implementation of the OKAI-1 recommendations under the three programs. As stated earlier, this appendix discusses only the impacts associated with Corps implementation actions, and the table should be viewed in this perspective.

TABLE 10-1 IMPACT COMPARISON OF BASIC, FIRST PRIORITY, AND GREAT F PROJECTS

PROJECT EVALUATIONS	FISH & WILDLIFE			WATER QUALITY			FLOODPLAIN			RECREATION			COMMERCIAL FISHING			ESTUARY		
	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G
Action Item 1 Dredged Material Placement Plan	●	●	●	●	●	●	●	●	●	○	○	○	○	○	○	●	●	●
Action Item 2 Interim Guidelines	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Action Item 3 Main stem Shoreline Protection	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Action Item 4 Reduced depth Dredging	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Action Item 5 Efficient Dredging Equipment	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Action Item 6 In Floodplain Placement of Dredged Material	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Action Item 7 Beneficial Use of Dredged Material	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Action Item 8 Temporary Material Placement Sites	●	●	●	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Action Item 9 Interim Guidelines for Water Quality Protection	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Action Item 10 Site Development Plans	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○

Legend: ○ = BENEFICIAL EFFECT  
● = ADVERSE EFFECT

F = FIRST PRIORITY G = GREAT F

Table D-4 IMPACT COMPARISON OF BASIC, FIRST PRIORITY, AND GREAT I PRO-RANK

RECOMMENDATIONS	FISH & WILDLIFE			WATER QUALITY			FLOODPLAIN			RECREATION			COMMERCIAL FISHING			CULTURAL RESOURCES		
	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G
Action Item 11 Chippewa River Sediment Control	○	○	○				○	○	○			○	○	○	○			
Action Item 12 Upland Soil Erosion Control	○	○	○	○	○	○	○	○	○			○	○	○	○	○	○	○
Action Item 13 Hazardous Material Shipping	○	○	○	○	○	○												
Action Item 14 Sanitary Pump-outs and Trash Pick-up					○	○			○	○								
Action Item 15 Staff and Budget Allocations		○	○															
Action Item 16 Gated Culvert at Lock and Dam 4	○	○	○															
Action Item 17 Gated Culvert at Lock and Dam 10	○	○	○															
Action Item 18 Expand Recreational Facilities on UMR&F Refuge																		
Action Item 19 Primitive Recreational Use Sites	●	●	●							○	○	○				●	●	●
Action Item 20 Lockage Waiting Areas										○	○	○	○	○	○	○	○	○

Legend: F = FIRST PRIORITY G = GREAT I ○ = BENEFICIAL EFFECT ● = ADVERSE EFFECT

Table D-1 IMPACT COMPARISON OF BASIC, FIRST PRIORITY, AND GREAT 1 PROJECTS

ACTION ITEM	FISH & WILDLIFE			WATER QUALITY			FLOODPLAIN			RECREATION			COMMERCIAL FISHERIES		
	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G
ACTION ITEM 1 NO. 11. NO. 12. NO. 13.															
Action Item 21 Recreational Facility Guides										○	○	○			
Action Item 22 Signing of Recreation Areas										○	○	○			
Action Item 23 Mark Control Structures											○	○			
Action Item 24 Uniform Noise Regulations															
Action Item 25 Great River Road Bikeway															
Action Item 26 Canoe Trails	●	●	●							○	○	○	○	○	○
Action Item 27 Port Snelling Back Channel										○	○	○	○	○	○
Action Item 28 Boating Safety										○	○	○			
Action Item 29 Boater Education										○	○	○			
Action Item 30 Boater Briefing															

LEGEND: F - FIRST PRIORITY G - GREAT 1 ○ - BENEFICIAL EFFECT ● - ADVERSE EFFECT  
INCREASED IMPACT ○ ○ ○ ○ ○

Table D-1 IMPACT COMPARISON OF BASIC, FIRST PRIORITY, AND GREAT I PROGRAMS

ACTION RECOMMENDATIONS	FISH & WILDLIFE			WATER QUALITY			FLOODPLAIN			RECREATION			COMMERCIAL FISHING						GREAT I
	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G	
Action Item 31 Water Patrol																			
Action Item 32 Pack-out Trash																			
Action Item 33 Topographic and Hydrographic Mapping																			
Action Item 34 Water Resource Projects on Tributaries																			
Action Item 35 Information and Education Programs																			
Action Item 36 Interagency Management Coordination Team																			
Action Item 37 Coordination Mechanisms																			
Action Item 38 Monitoring of GREAT I Implementation																			
Action Item 39 Total River Resource Management Plan																			

Legend: F = FIRST PRIORITY G = GREAT I ○ = BENEFICIAL EFFECT ● = ADVERSE EFFECT

TABLE D-1 IMPACT COMPARISON OF BASIC, FIRST PRIORITY, AND GREAT I PROGRAMS

PROGRAMS	FISH & WILDLIFE			WATER QUALITY			FLOODPLAIN			RECREATION			CONSERVATION			CULTURAL		
	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G
POLYCE/PLINDING ITEM 1 Maintenance of the Navigation Channel	○	○	○					○		○	○	○	○	○	○			
POLYCE/PLINDING ITEM 2 Long-term plan to Implement the Channel Maintenance Program	○	○	○	○	○	○	○	○	○	●	●	●	○	○	○			
POLYCE/PLINDING ITEM 3 Emergency Dredging Definition	○	○	○	○	○	○							○	○	○			
POLYCE/PLINDING ITEM 4 Emergency Dredging Capability													○	○	○			
POLYCE/PLINDING ITEM 5 Sell Dredged Material	○	○	○					●		●	●	●						
POLYCE/PLINDING ITEM 6 Acquisition of Private Land	○	○	○	○	○	○	○	○	○	●	●	●						
POLYCE/PLINDING ITEM 7 Management of Laws and Regulations	○	○	○	○	○	○	○	○	○	○	○	○						
POLYCE/PLINDING ITEM 8 Define 9 Foot Navigation Project								○	○									
POLYCE/PLINDING ITEM 9 Management Plan for the Refuge	○	○	○															
POLYCE/PLINDING ITEM 10 Manage River as Ecological Unit	○	○	○															

○ = FIRST PRIORITY    ○ = GREAT I    ○ = BENEFICIAL EFFECT    ● = ADVERSE EFFECT    ○ = INCREASED IMPACT



Table D-1 IMPACT COMPARISON OF AWP, FIRST PRIORITY, AND OTHER PROJECTS

RECOMMENDATIONS	FISH & WILDLIFE			WATER QUALITY			FLOODPLAIN			RECREATION			CONSERVATION			OTHER		
	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G
Policy/Funding Item 11 Provide Corps with authorities for fish and wildlife & rec.	○	○	○							○	○	○						
Policy/Funding Item 12 Budget line items for fish & wildlife and recreation																		
Policy/Funding Item 13 Beneficiary/User data																		
Policy/Funding Item 14 Unified Management Objectives		○	○				○			○	○	○		○				
Policy/Funding Item 15 Exotic Organism Control																		
Policy/Funding Item 16 Scenic Easements/Acquisitions										○	○	○						
Policy/Funding Item 17 Enforcement of Bridge Operating Regulations																		
Policy/Funding Item 18 Rebuild Obstructive Bridges																		
Policy/Funding Item 19 Control Boathouse Permits	○	○	○	○	○	○				○	○	○						
Policy/Funding Item 20 Monitor Lockages										○	○	○						

1 - FIRST PRIORITY      GREAT      ○ - BENEFICIAL EFFECT      ● - ADVERSE EFFECT      IN-GRAND TOTAL      ○ ○ ○ ○ ○

Table D-1 IMPACT CATEGORIZATION OF BASIN, LIFE & PRODUCTION, AND RECREATION

GREAT 1 RECOMMENDATIONS	FISH & WILDLIFE			WATER QUALITY			FLOODPLAIN			RECREATION			COMMERCIAL FISHERY			LIFE & PRODUCTION		
	B	F	C	B	F	C	B	F	C	B	F	C	B	F	C	B	F	C
Policy/Funding Item 21 Discourage High Impact Recreational Development	○	○	○							●	●		●					
Policy/Funding Item 22 Recreation Surveys										○	○							
Policy/Funding Item 23 Provide a Diversity of Recreational Opportunities										○	○							
Policy/Funding Item 24 Maintain Recreational Fees, Launching Accesses										○	○							
Policy/Funding Item 25 Uniform Standards for Floodplain Management							○	○	○									
Policy/Funding Item 26 Monitoring of GREAT 1 Recommendations																		

F - FIRST PRIORITY G - SECOND PRIORITY H - THIRD PRIORITY I - FOURTH PRIORITY J - FIFTH PRIORITY K - SIXTH PRIORITY L - SEVENTH PRIORITY M - EIGHTH PRIORITY N - NINTH PRIORITY O - TENTH PRIORITY

TABLE D-1 IMPACT COMPARISON OF BASIC, FIRST PRIORITY, AND GREAT I CDD CANAL

FLOOD PRECIPITATIONS	FLOOD & REILUREL			WATER QUALITY			FLOODPLAIN			RECREATION			CORRUPTAL EFFECTS			P	B
	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G		
Further Study Item 1 Demonstration dredging Project																	
Further Study Item 2 Use River Sediment Transport capability	○	○	○				○	○	○							○	○
Further Study Item 3 Develop Computerized Sediment Transport Model																	
Further Study Item 4 Dredge at Tributary Confluences																	
Further Study Item 5 Review Condition of Wing Dams	○	○	○										○	○	○		
Further Study Item 6 Low head dams on Tributaries																	
Further Study Item 7 Sand and gravel companies accomplishing dredging	○	○	○							●	●	●					
Further Study Item 8 Monitor impacts on water quality				○	○	○											
Further Study Item 9 Streambank Erosion survey	○	○	○														
Further Study Item 10 Sediment Control - Pool 3 Tributaries																	

F = FIRST PRIORITY    G = GREAT I    ○ = BENEFICIAL EFFECT    ● = HARMFUL EFFECT    P = POOR    B = BENEFICIAL

Table D-1 IMPACT COMPARISON OF BASIC, FIRST PRIORITY, AND GREAT PRIORITY

RECOMMENDATIONS	FISH & WILDLIFE			WATER QUALITY			FLOODPLAIN			RECREATION			COTTON COTTON		
	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G
Further Study Item 11 Investigation of Riverine Placement				●	●	●									
Further Study Item 12 Remove Dredge Material From Floodway	○	○	○				○	○	○						
Further Study Item 13 Transport Dredged Material to Areas of High Demand															
Further Study Item 14 Private Enterprise Transport Sand															
Further Study Item 15 Use Dredged Material to Make riprap															
Further Study Item 16 Beneficial Use of Organic Sediments															
Further Study Item 17 Conservation Tillage Farm- ing Systems															
Further Study Item 18 Monitor Sediment Inflow															
Further Study Item 19 Protect Critical Backwater Areas		○	○												
Further Study Item 20 Island Creation	○	○	○												

10 1 - FIRST PRIORITY G - GREAT P - GREAT PRIORITY  
 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

Table D-1 IMPACT COMPARISON OF BATHO, FIRST PRIORITY, AND GREAT I PROGRAMS

RECOMMENDATIONS	FISH & WILDLIFE			WATER QUALITY			FLOODPLAIN			RECREATION			COMMERCIAL FISHERY		
	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G
Further Study Item 21 Weaver Bottoms Rehabilitation	○	○	○				●	●		○	○	○			
Further Study Item 22 Finger Lakes as Physical Model															
Further Study Item 23 Big Slough - Big Lake Sedimentation Control	○	○	○							○	○	○			
Further Study Item 24 Lake Onalaska Sedimentation Control	○	○	○							○	○	○	●	●	●
Further Study Item 25 Spring Lake Rehabilitation	○	○	○	●	●	●	●	●		○	○	○			
Further Study Item 26 Kruger Slough - Island 42 Monitoring Program															
Further Study Item 27 Mapping of Submerged Aquatic Features	○	○	○												
Further Study Item 28 Pool Level Control for Fish and Wildlife	○	○	○							○	○	○			
Further Study Item 29 Identify Natural Areas										○	○	○	○	○	○
Further Study Item 30 Forest Management															

F - FIRST PRIORITY    G - GREAT I    ○ - BENEFICIAL EFFECT    ● - ADVERSE EFFECT    INCREASED POPULATION

TABLE D-1 IMPACT COMPARISON OF BASIC, FIRST PRIORITY, AND GREAT I PROGRAMS

RECOMMENDATIONS	FISH & WILDLIFE			WATER QUALITY			FLOODPLAIN			RECREATION			COMMERCIAL FISHING			TOTAL
	B	F	G	B	F	G	B	F	G	B	F	G	B	F	G	
Further Study Item 31 Management of Bottomland Hardwoods for Wildlife	○	○	○													
Further Study Item 32 Life History of Fishes																
Further Study Item 33 Culvert Placement at Blackhawk County Park	○	○	○													
Further Study Item 34 Aesthetic Management	○	○	○						○	○						
Further Study Item 35 Review & Regulation of Commercial Navigation													○	○	○	
Further Study Item 36 Fleet Area Study													○	○	○	
Further Study Item 37 Mark Channel in Lake Pepin									○	○			○	○	○	
Further Study Item 38 Capacity Studies at L/D#2 and L/D#3									○	○			○	○	○	
Further Study Item 39 Navigational Aid System									○	○			○	○	○	
Further Study Item 40 Recreation Master Plan									○	○						

○ = FIRST PRIORITY    ○ = GREAT I    ○ = BENEFICIAL EFFECT    ○ = AVERAGE EFFECT    ○ = IMPROVING IMPACT



Action Items 1 and 12 will be used to illustrate how to use the table. Action Item 1 is implementation of the GREAT I Channel Maintenance Plan (CMP), a major Corps responsibility with substantial impacts on fish and wildlife. The magnitude of impact is indicated in the table by the large circle following Action Item 1 under Fish & Wildlife. Action Item 12 (upland erosion control in the critical sediment source area of the Upper Mississippi River and tributaries) may have much greater impact on fish and wildlife than Action Item 1. If the Corps had implementation responsibility for this item, a large circle would be shown in the table. However, the Soil Conservation Service has primary responsibility for this item and the Corps can only lend support. Thus, small circles following Action Item 12 in the table under Fish & Wildlife reflect the minimal impact from Corps action.

A discussion of impacts by major resource area or user group follows.

#### FISH AND WILDLIFE

Corps activities have affected fish and wildlife resources of the Upper Mississippi River in many ways. The most significant effects have resulted from operation and maintenance of the navigation pools, maintenance of the 9-foot navigation channel, and management of Federal lands.

The GREAT I recommendations take two basic approaches in dealing with the actual and potential effects of Corps activities on fish and wildlife:

1. Reducing the impacts of actions associated with maintenance of the navigation system.
2. Enhancing fish and wildlife resources.

The Basic Program generally concentrates on reducing the adverse impacts of ongoing activities. The Fish Priority and GREAT I Programs include positive efforts to enhance fish and wildlife. The basic philosophy behind



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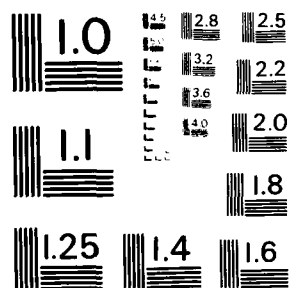
IMPLEMENTATION FOR GREAT I STUDY(U) CORPS OF ENGINEERS  
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MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS - 963-10A

this approach is that the adverse impacts of operation and maintenance are, many times, long term and irreversible. Thus, steps to minimize them need to be taken as soon as possible. Most enhancement measures do not have the same urgency and are given somewhat lower priority. Another reason for not including enhancement in the Basic Program is that enhancement efforts generally are not required by any regulatory function and can be delayed if time and funds are not available. In contrast, adverse effects associated with operation and maintenance are in many cases subject to regulatory control and must be minimized as they occur.

Following is a discussion of the recommendations with the greatest impact on fish and wildlife.

#### Action Item 1

Action Item 1 is the GREAT I CMP. Maintenance dredging has adverse effects on fish and wildlife resources mainly through (1) degradation and loss of habitat resulting from placement and (2) secondary movement of dredged material from placement areas into adjacent habitats because of erosion, primarily caused by floodwaters.

One basic criterion used in the development of the CMP was to minimize impacts on fish and wildlife. The end result is a plan that, over the next 40 years, would alter approximately 315 acres of Type 1-2 wetlands, primarily bottomland hardwoods and wet meadows. Of this total, 80 acres would be filled as part of the Holman Field airport expansion in St. Paul (pool 2). Approximately 250 acres of Type 3-4-5 deep marshes would be lost, including 30 acres at the Holman Field expansion, 76 acres at the Weaver Bottoms fish and wildlife enhancement project, and 21 acres at the Winona Industrial Park. Additionally, 500 acres of upland habitat, most of which has been disturbed, would be used for placement. The problem of secondary movement of the dredged material would be essentially eliminated in the CMP because most of the placement sites are out of the floodplain.

The CMP would be implemented under the First Priority and GREAT I Programs. Habitat losses to direct placement with the CMP would probably be less than those indicated above because of the built-in flexibility of the plan that allows incorporation of new placement sites with lesser impacts.

The Basic Program calls for implementation of as much of the CMP as feasible within funding limits and equipment capability. The extent of implementation would vary from year to year depending on annual dredging requirements and funds available. Another important factor is that many of the CMP sites are privately owned and their availability is uncertain.

Over a 40-year period, the Basic Program would result in greater habitat degradation and losses than those projected for the CMP. How much greater cannot be accurately predicted, but it would occur for several reasons.

Many of the CMP sites are on non-Federal lands. Whether they can be used for placement is unknown. About 16 CMP sites in non-Federal ownership have never been used for placement, but they are important in the CMP (as far as volume of placement and number of dredge cuts is concerned). These sites total approximately 370 acres: 41 acres agricultural land, 87 years old sand and gravel pit, 85 acres disturbed upland, 25 acres upland meadow, 92 acres Type 1 wetland, and 40 acres Type 3-4 wetlands. Material can be removed from these sites for beneficial use, reducing the acreages needed for placement. If some or all of these sites cannot be used, alternative sites would have to be found. These alternatives would most probably be on Federal land, much of it undisturbed wetlands, resulting in the loss of more valuable habitats than those on the selected CMP sites on private lands. In addition, most of the Federal land is not readily accessible by land transportation, making beneficial use of the material less probable. As a result, more habitat would be lost because of the need for increased acreages to handle projected future volumes of dredged material. This one factor of land ownership can substantially increase the fish and wildlife impacts of the Basic Program compared with those that would occur with full implementation of the CMP.

Equipment and funding limits may also require use of lands closer to the river than many of the CMP sites. Effects on fish and wildlife would tend to increase because most areas close to the river are high quality wetland habitats. Also, areas close to the river are probably less accessible for beneficial use removal than the CMP sites, increasing the acreages of habitat taken to provide capacity.

#### Action Item 10

This recommendation calls for development plans for all historic and proposed placement sites. This effort would benefit fish and wildlife by returning placement sites to biological productivity at a faster rate than would be probable naturally. Also, stabilization of sites would reduce impacts caused by secondary movement of dredged material.

The Basic Program calls for the development plans at several sites; the First Priority Program would have development plans for all sites. Thus, the First Priority Program would have greater fish and wildlife benefits than the Basic Program. However, the specific number, size, and type of sites that plans would be developed for under each program would have to be determined before the impacts could be quantified. The potential fish and wildlife benefits of rehabilitating historic placement sites would also depend on the emphasis placed on maintaining these sites for recreation (see Action Item 19).

#### Action Item 19

This recommendation calls for maintaining primitive recreation areas along the river, primarily on historic placement sites. Thirty of these sites have been identified.

The biological productivity of these sites would be kept low because the sites are maintained primarily in an open sandy condition. Also, these sites are designed to attract recreationists and the increased human activity would have adverse impacts on those few species of wildlife that could make use of the habitat.

As efforts are increased in maintaining and developing these areas for recreational use, the First Priority and GREAT I Programs would have increasingly adverse fish and wildlife impacts resulting from habitat losses and increased human activity. These impacts are not quantifiable at this time.

#### Policy/Funding Item 6

The Corps of Engineers would change its policy and allow private lands to be acquired for dredged material placement. This change could substantially benefit fish and wildlife. (See the discussion under Action Item 1 on the question of use of private lands for placement in relation to fish and wildlife habitat losses.)

#### Policy/Funding Item 11

This recommendation calls for Congress to give the Corps more definitive authority and funds for fish and wildlife enhancement. Under the Basic Program, the St. Paul District would continue to operate under Public Law 89-72 and Code 710 authorities which require that projects be on Corps-controlled lands and a non-Federal sponsor assume 50 percent of implementation costs and responsibility for any necessary operation and maintenance.

On the basis of past experience, few fish and wildlife enhancement measures would be accomplished under the Basic Program. In the 15 years since the authorities have been in existence, only one fish and wildlife enhancement project has been undertaken under these authorities.

Two primary reasons account for the lack of enhancement projects under these authorities:

1. It is difficult to find non-Federal sponsors interested in fish and wildlife enhancement projects. Enhancement projects on the Upper Mississippi River tend to be large and expensive because of the nature of the resource. It is difficult for a non-Federal sponsor to afford even 50 percent of project costs. In addition, the benefits accrue to a large interstate public resource making it difficult for local entities to recognize the benefits from these projects to justify local costs.

2. The St. Paul District does not actively seek out fish and wildlife enhancement projects. Instead, the District tends to wait for non-Federal sponsors to come forward. This tendency, coupled with little knowledge of available programs on the part of the potential non-Federal sponsors, does not stimulate interest in enhancement projects by non-Federal sponsors.

Under the First Priority Program, the St. Paul District would seek out local sponsors. The result of this approach may be to get the States to act as non-Federal sponsors for some of the projects identified by GREAT I as worthy of study (such as Weaver Bottoms, Spring Lake, Big Slough, Lake Onalaska, and other backwater-type improvement projects). Unless the Corps makes a conscious effort to identify small local enhancement projects that will have identifiably local benefits and will not have significant costs, it is unlikely that non-Federal sponsors such as cities and counties will become very much involved even under the First Priority Program.

The GREAT I Program assumes Congress will give the Corps more active authority to undertake fish and wildlife enhancement projects by changing or eliminating cost-sharing requirements. Under this program, the Corps would be able to request funds for and undertake justifiable fish and wildlife enhancement efforts. This would benefit fish and wildlife by making it easier for the District to accomplish justifiable fish and wildlife enhancement measures when the opportunity arises, especially during on-going operation and maintenance (such as dredging). How much enhancement could be accomplished if the District were given more liberal authorities would depend on how active the District desired to be in this area and the ability of the Fish and Wildlife Service and the States to agree on which actions should be implemented.

#### Further Study Item 21

This recommendation is for the study and rehabilitation of the Weaver Bottoms. This project would benefit the 4,000-acre Weaver Bottoms, a deep marsh-shallow lake area in pool 5. The project would reduce the

scouring effect of currents entering the Weaver Bottoms and reduce wind-induced turbidity, allowing for the reestablishment of aquatic vegetation. In the long term, the project should also reduce the rate of sedimentation throughout the backwater.

Under the Basic Program, the Corps would be active in the planning and implementation because the project has the long-term potential to provide a use for the dredged material from the lower four cuts in pool 5 (approximately 1,658,000 cubic yards of material). The Corps would be able to participate in cost sharing for any structures needed for the project.

The First Priority and GREAT I Programs would be essentially the same as the Basic Program unless Congress changes Corps authorities (see Policy/Funding Item 11).

#### Further Study Items 23, 24, and 25

These three recommendations are for studies to develop protection for and/or rehabilitation of three large backwater lakes - Big Lake (pool 9), Lake Onalaska (pool 7), and Spring Lake (pool 2). Big Lake is a 1,200-acre fishing lake threatened by sedimentation entering the upper reaches of the lake via Big Slough. Lake Onalaska is an excellent 5,400-acre waterfowl and fishing lake threatened by sediment entering the lake through side channels from the main channel. Spring Lake is an approximately 1,200-acre lake that has limited fish and wildlife value in its present state. Its habitat value could probably be improved if it could be separated to some extent from the main channel to reduce the effects of current, sedimentation, and poor water quality.

Under the Basic Program, the Corps would defer lead efforts in the studies to the U.S. Fish and Wildlife Service or the appropriate State. The Corps would provide technical expertise on a requested basis and participate in justifiable projects using Public Law 89-72 or Code 710 authorities. It is unlikely that these three enhancement projects will be studied and accomplished in the foreseeable future under the Basic Program. Some of the general problems in enhancing fish and wildlife are discussed under Policy/Funding Item 11.



Under the First Priority Program, the Corps could take an active lead in the necessary studies. The Corps can use existing authorities to develop conceptual measures for fish and wildlife enhancement. This activity does not need to be cost shared. Thus, one of the obstacles (high initial study costs) that may keep the Fish and Wildlife Service or the States from undertaking these studies under the Basic Program would be removed. The obstacle of finding a non-Federal sponsor would not be removed, but the efforts along these lines would increase the potential for finding a sponsor. While the First Priority Program and the GREAT I Program do not guarantee that these fish and wildlife enhancement projects would ever be implemented, they considerably increase the potential for implementation.

#### WATER QUALITY

Water quality is closely regulated by both the Federal and State governments. The principal consideration of water quality was in the area of channel maintenance. Three particular recommendations relating to water quality are worthy of note.

##### Action Item 1

Action Item 1 is implementation of the CMP. The impact of Corps maintenance dredging on water quality has long been controversial. Adverse impacts have been greatly reduced from pre-GREAT I days as a result of increased awareness of the problem, Federal and State laws and regulations, and subsequent changes in dredging and placement methods.

Corps dredging is controlled by Federal and State laws, regulations, policies, etc., relating to water quality. Regulations are stringent, and, coupled with other environmental requirements, do an excellent job of minimizing adverse water quality impacts. Regardless of whether part (Basic Program) or all (First Priority Program) of the CMP is implemented, water quality impacts during dredging and placement will continue to be closely regulated. Therefore, the difference in impacts of these two programs will probably be small.

#### Action Item 9

Action Item 9 recommends that the Environmental Protection Agency develop criteria for water quality and sediment quality related to dredging and that the States use these criteria to develop regulations for dredging and placement. The St. Paul District has pressed and will continue to press for these actions. At the very least, development of criteria should provide for more consistent evaluation and regulation of water quality impacts.

Action Item 9 contains a set of interim guidelines to protect water quality during channel maintenance until applicable criteria and regulations are developed. Many of these guidelines are required by Federal and State water quality regulatory programs; they have been part of the St. Paul District's basic program since 1974. Implementation of these guidelines as identified under the Basic Program, coupled with compliance with existing water quality regulations, would adequately protect water quality during channel maintenance operations.

The one difference between the Basic, First Priority, and GREAT I Programs has to do with guideline f. of Action Item 9. This guideline pertains to the posting of warnings to recreationists where contaminated sediments are dredged. Significantly greater benefits are not expected from the First Priority and GREAT I Programs because:

1. Contaminated sediments are adequately contained in all but emergency dredging situations. Even then, at times they are adequately contained.
2. Contaminated sediments are generally limited to the Twin Cities metro area.
3. The Upper Mississippi River in the metro area is not generally used for body contact water sports because the water quality is poor.

#### Action Item 14

Action Item 14 recommends placing sanitary pump-out facilities and trash pickups at the locks and dams. The Basic Program would establish neither while the First Priority Program would place trash pickup at several locks on a trial basis for 2 to 3 years.

It is difficult to evaluate the water quality impacts of the three programs because the magnitude of the problem of sanitary waste dumping and littering has never been documented. Neither has the basis for the problem been established - is it caused primarily by a lack of facilities or carelessness by those who dump wastes or litter?

Installation of these facilities as recommended by GREAT I is not judged to provide appreciable water quality benefits over the no action of the Basic Program. It is unlikely that dumping of sanitary wastes from boats creates more than very localized impacts and littering is more of an aesthetic than a water quality problem. In addition, because adequate pump-out facilities are available for towboats and the private sector does provide pump-out facilities in some locations for recreational craft, it appears that carelessness by boaters is a greater contributor than lack of facilities.

#### FLOODPLAIN

Corps operation and maintenance activities generally have little or no impact on the floodplain and flood flows. No significant impacts on the floodplain have been identified for implementation of any of the GREAT I recommendations in which the Corps would be involved. Thus, differences in

floodplain impacts between the Basic, First Priority, and GREAT I programs are not substantial. The following recommendations are discussed to demonstrate the lack of impact.

#### Action Item 1

Analysis in the St. Paul District indicates that dredged material placement in the floodplain has immeasurably small impacts on flood flows and levels because the total area of the placement sites is such a small percentage of the area of the floodplain. Implementation of the GREAT I CMP would have even less impact on the floodplain because almost all of the selected placement sites are out of the floodplain. But the differences in impact between the Basic and First Priority Programs would be negligible because the impacts are already so slight.

#### Further Study Item 12

Further Study Item 12 recommends that dredged material placed in the floodplain be removed. Because placement in the floodplain has little impact on flood flows, it is unlikely that the different levels of effort proposed under the three programs will produce appreciably different impacts.

#### CULTURAL RESOURCES

GREAT I made one recommendation pertaining to cultural resources (Further Study Item 45). The St. Paul District's cultural resource program encompasses and exceeds that recommended by GREAT I. The St. Paul District's program includes an ongoing literature survey of areas affected by the 9-foot navigation channel and field investigations of areas affected by ongoing operation and maintenance actions. In the future, it will include a field inventory for some or all of the cultural resources in the project area. It will continue to expand the knowledge of the project area's cultural resources and provide for their protection.

## COMMERCIAL NAVIGATION

The most important point relating to commercial navigation under all three programs is that the 9-foot navigation channel would be maintained to provide safe navigation for commercial transportation. Many of the GREAT I recommendations emphasize increased consideration of other resource values during operation and maintenance of the navigation system. In any program to implement the GREAT I recommendations, the weight given to commercial navigation interests in decision-making processes would be reduced. Thus, the First Priority and GREAT I Programs would be less favorable to commercial navigation interests than the Basic Program and the Basic Program less favorable than pre-GREAT I historic operation and maintenance practices.

The following recommendations have the most impact on commercial navigation.

### Action Item 1

Implementation of the GREAT I CMP would result in a safe navigable 9-foot channel. The basic differences between partial implementation (Basic Program) and full implementation (First Priority Program) are the matters of cost and reliability.

Full implementation of the CMP would cost more than partial implementation. Increases in costs for channel maintenance without increased appropriations from Congress could postpone repair of locks and dams, increasing the potential for a breakdown that could delay or block river traffic.

Full implementation of the CMP would exceed the capability of St. Paul District's existing available equipment and would require careful planning of acquisition of future equipment to provide for orderly implementation.

#### Action Item 4

Action Item 4 calls for reduced-depth dredging with exceptions for safety reasons. Historically, dredging was normally done to a depth of 13 feet; the first 2 feet of overdepth dredging (between 9- and 11-foot depths) provided a margin of safety and the next 2 feet (between 11- and 13-foot depths) minimized dredging frequency. Studies indicate that the 2 feet of advance maintenance dredging to reduce dredging frequency may not be necessary in all cases.

Although 11 feet provides a safe depth for 9-foot draft vessels, it is not as efficient for commercial vessels as a 13-foot depth in terms of vessel speed, maneuverability, and fuel efficiency. Thus, reducing dredging depths could have adverse economic impacts on commercial transportation in terms of fuel costs. This impact is not quantifiable at this time.

#### Further Study Item 38

This recommendation calls for studies of projected lock capacity problems at locks and dams 2 and 3. The First Priority Program would provide for a higher level of effort than the Basic Program and, thus, should prove more beneficial to commercial navigation interests.

#### RECREATION

Recently, the St. Paul District began to update its master plan for public use development and resource management for the 9-foot channel project. This study will incorporate analysis of many of the recreation-related recommendations of the GREAT I study. These recommendations range from having potential negative impacts on recreation by reducing dredged material available for beaches to positive impacts from expanding Corps authorities for planning and management of new recreation resources. The Basic Program responses to many of the recommendations are constrained by existing authorities as well as funding and personnel limitations. First Priority and GREAT I Programs implementation will largely depend on the removal or lessening of these constraints.

#### Action Item 1

Implementation of the CMP will generally reduce the amount of dredged material available for maintaining or enhancing existing or new placement area sites for river recreation uses. Ongoing placement of material on recreation use sites is important because it controls vegetation growth and provides sandy beach areas. Enhancement of new sites in carefully located areas is important in attempting to improve the quality of a recreation experience on the river and manage for appropriate uses in specific areas. The Basic, First Priority, and GREAT I Programs would all benefit the recreation resource, although the benefits will be somewhat less with implementation of the CMP.

#### Action Item 3

Shoreline protection could reduce access to areas used by recreationists. The Basic Program would have little impact in this area. The First Priority and GREAT I Programs could have greater adverse impacts on recreational access because more shoreline would be protected.

#### Action Item 7

As more dredged material is put to beneficial use away from the river, less is available for beach nourishment. The First Priority and GREAT I Programs would have greater adverse impacts on recreation for this reason.

#### Action Item 10

Plans for active and historic placement sites would benefit recreation because recreational use would be considered in the development of these plans. The First Priority Program would have greater benefits than the Basic Program because more site plans would be developed.

Action Item 19

From a recreational use standpoint, it is important to maintain primitive recreational sites. The Basic, First Priority, and GREAT I Programs would have increasingly greater beneficial impacts on recreation values.

Policy/Funding Item 11

If the Corps were given more definitive authorities and funds to enhance recreation, recreation would benefit through a greater number of recreation projects. The GREAT I Program would be more beneficial than the Basic and First Priority Programs.

Policy/Funding Item 22

Increased data collection to provide a reliable data base for recreation resource management should benefit recreation through more serviceable recreational developments. The First Priority and GREAT I Programs would have progressively greater benefits.

Further Study Items 21, 23, 24, and 25

Fish and wildlife habitat improvement programs at Weaver Bottoms, Lake Onalaska, Big Lake, and Spring Lake would increase hunting, fishing, bird-watching, and other recreational opportunities.

Further Study Item 41

Increased development of recreation projects would improve recreational experiences and increase recreational opportunities. The First Priority and GREAT I Programs would substantially benefit recreation.



APPENDIX E

ECONOMIC ANALYSIS

UPPER MISSISSIPPI RIVER AREA  
(HEAD OF NAVIGATION TO GUTTENBERG, IOWA)

ST. PAUL DISTRICT  
U.S. ARMY CORPS OF ENGINEERS  
JUNE 1981

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APPENDIX E  
ECONOMIC ANALYSIS

COSTS

INTRODUCTION

This section presents the costs for maintenance of the 9-foot channel and operation and care of locks and dams from 1937 (when most of the 9-foot channel navigation system in the St. Paul District was in operation) through 1979. Channel maintenance costs include costs on the Minnesota and St. Croix Rivers in addition to costs on the Mississippi River from Minneapolis, Minnesota, through lock and dam 10 at Guttenberg, Iowa. During this period, wages and material costs have increased regularly; they are now over 12 times greater than they were in 1937. Prices doubled in the 13-year period following 1958 and doubled again in the next 8 years. This change in price levels has made it difficult to analyze the impacts of changes in dredging and material handling procedures and other actions designed to protect and enhance natural resources. Accordingly, all maintenance and operation costs have been adjusted to 1979 price levels. Costs for lock and dam operation and care are easily adjusted, but adjustments in channel maintenance costs are more complex. The latter costs relate to quantities dredged, and several variables must be taken into account, including the changes in use of the hydraulic cutterhead dredge, William A. Thompson, from a 24-hour, four-crew operation during the 1930's and into the 1940's to two crews and a shorter operating day as well as the use of the dredge outside the St. Paul District (beginning in the late 1950's). Also, the cost-quantity dredged relationship is affected by the proportion of dredging done by the Derrickbarge Hauser which is slower and less efficient in most large operations. Further, channel maintenance costs since about 1973 cannot be compared directly to earlier costs because of the acquisition and use of equipment to move material removed by the Thompson over greater distances, reduced-depth dredging, major studies undertaken, water quality monitoring, and other actions required to comply with State and Federal regulations.

Costs are developed on an average annual basis; first, assuming no change from the river maintenance procedures followed before 1974 and, second, assuming that the practices followed since 1974 would have prevailed throughout the 43-year period.

Average annual benefits for long-haul commodity movements to or from the St. Paul District are based on the District share of the savings in transportation charges to shippers who use the Upper Mississippi River waterway system. Intra-District commercial traffic on the 9-foot channel is also taken into account. Waterborne commerce benefits are the savings in transportation costs from point of origin to destination by water as compared to those for the least-cost alternative mode.

Fiscal records for the 9-foot channel project on the Mississippi River are recorded by each District and are divided into four principal categories: new work, maintenance, rehabilitation, and operation and care. New work includes planning and construction of separate project features authorized by Congress such as the locks and dams, small-boat harbors, and recreation areas. Maintenance includes (in addition to the regular dredging and material placement costs) repairs to the locks and dams and related project features, channel surveys and reports, bank protection and other repairs to nonproject features affected by project operation, water quality monitoring, installation and operation of gages, and other work required periodically. Rehabilitation includes major replacement or repair of existing facilities, such as the current work at locks and dam 1 in Minneapolis. Operation and care covers primarily the continuing on-site labor required to regulate the flow-control gates and the locks for passage of river traffic plus the necessary District office labor required to direct and coordinate these operations. All costs are subject to a share of the District overhead and other administrative costs. Project costs are summarized in the Annual Reports of the Chief of Engineers and itemized in greater detail in the District office records.

In 1976, the Federal Government changed its fiscal year from the 12-month period 1 July through 30 June to 1 October through 30 September. This change required separate funding of a transition quarter in

1976 and costs were accumulated accordingly. As a result, any series of cost data extending through 1976 includes an odd quarter year identified separately or carried in a 15-month fiscal year for 1976. The TQ data are shown separately in this analysis so the years can be compared.

#### MAINTENANCE AND OPERATION

These costs are divided into two main groups: (1) those for channel maintenance and related activities and (2) lock and dam operation and care and related, other work. Lock and dam costs and other costs can be adjusted to constant price levels by applying the appropriate cost index. However, channel maintenance costs involve other variables which must be taken into account. The procedures developed for adjusting all costs to 1979 average price levels are presented in the following paragraphs.

#### Projections of Dredging Costs

Costs for channel maintenance and related activities have increased significantly in the last few years, but the quantities dredged have all been relatively low, varying from 250,000 to 1,000,000 cubic yards annually. This limited experience does not provide a firm basis for predicting probable costs if larger quantities need to be removed. However, dredging and placement quantities and costs can be obtained from the annual reports of the Chief of Engineers for each year as far back as 1937 when most of the locks and dams were in operation and the Dredge Thompson was acquired. This 37-year period, from 1937 through 1973, provides cost data for annual dredging quantities varying from 500,000 to 5,000,000 cubic yards. During this period, emphasis was on maintaining the channel in the most economical manner with lesser concern for the effects on the environment. Nevertheless, this long-term cost experience provides a base for developing probable dredging and material placement costs under current policies and practices for a full range of possible dredging quantities.



### Adjustment of Costs to Constant Price Levels

One of the principal variables which affects comparison of past and present costs is the continuing change in wage rates and prices of materials. A fixed price base is essential for an understanding of the effects of other variables. Thus, for this analysis, 1979 has been selected as the base year, and all costs have been converted to average price levels prevailing in that year. Wage rates, which are a major part of maintenance costs, were obtained for the river area and compared with the Engineering News Record (ENR) construction index for the same period. Both follow an almost identical pattern leading to the conclusion that the ENR construction index provides a sound basis for adjusting most of the maintenance and operation costs to a 1979 price level. However, dredging and placement costs cannot be converted directly to 1979 price levels using the construction index. In this case, changes in equipment use and other factors must be taken into account. The procedure followed is described in the following paragraphs.

As a first step, quantities dredged on the Mississippi, Minnesota, and St. Croix Rivers and costs for each fiscal year since 1937 were obtained from the annual reports and are given in table E-1. For the first half of the period, costs were limited to river surveys and dredging; later, additional items of channel maintenance were included in the overall maintenance costs. These additional work items were separated and carried as other maintenance costs. These additional work items were separated and carried as other maintenance costs. On the basis of the record, costs for dredging and material placement varied from less than \$0.10 per cubic yard in the first few years to about \$0.59 per cubic yard in 1972. In 1973, costs declined slightly; thereafter, they climbed rapidly to over \$5.00 per cubic yard in 1977, the year of lowest dredging quantity when about 90 percent of the dredging was accomplished by the Hauser. Further, quantities and costs for fiscal years following 1976, although covering a 12-month period, are not strictly comparable to those of the preceding years because of the change in 1976 from a fiscal year ending 30 June to one that ends 30 September. The rapid increase in dredging costs after 1973 suggests that cost adjustments to 1979 price levels might best be carried out in two stages: the first for the period 1937 through 1973 and the second for the following years.

Table E-1 - Dredging quantities and costs, maintenance of 9-foot channel

Fiscal year	Dredging quantity (1,000 cubic yards)				Cost (\$1,000's)				Cost per cubic yard (\$)
	Missis- sippi River	Minne- sota River	St. Croix River	Total	Missis- sippi River	Minne- sota River	St. Croix River	Total	
1937	2,614	0	0	2,614	298	0	6	304	0.116
1938	5,380	0	125	5,505	393	12	16	421	0.076
1939	4,251	0	0	4,251	357	0	1	358	0.084
1940	2,362	0	0	2,362	202	6	1	209	0.088
1941	1,929	0	104	2,033	231	0	10	241	0.119
1942	2,841	0	0	2,841	269	2	1	272	0.096
1943	3,682	0	0	3,682	409	0	0	409	0.111
1944	1,885	0	0	1,885	257	0	0	257	0.136
1945	3,347	0	0	3,347	422	0	0	422	0.126
1946	2,640	0	352	2,992	433	10	35	478	0.160
1947	1,808	0	0	1,808	374	0	0	374	0.207
1948	2,200	0	0	2,200	399	0	0	399	0.181
1949	2,193	0	86	2,279	419	0	16	435	0.191
1950	2,372	0	11	2,383	590	1	7	598	0.251
1951	1,566	0	30	1,596	457	2	5	464	0.291
1952	1,746	0	0	1,746	406	0	0	406	0.233
1953	1,885	0	0	1,885	533	3	2	538	0.285
1954	2,325	0	28	2,353	576	2	28	606	0.258
1955	1,982	0	0	1,982	476	1	0	477	0.241
1956	1,592	0	0	1,592	486	7	5	498	0.313
1957	1,384	0	46	1,430	515	2	7	524	0.366
1958	1,279	0	10	1,289	457	8	10	475	0.369
1959	1,005	0	0	1,005	326	4	2	332	0.330
1960	1,255	5	0	1,260	452	20	0	472	0.375
1961	678	2	33	713	318	5	4	327	0.459
1962	665	0	0	665	323	5	14	342	0.514
1963	1,468	0	0	1,468	404	15	5	424	0.289
1964	1,084	4	0	1,088	497	25	0	522	0.480
1965	1,382	0	0	1,382	580	10	0	590	0.427
1966	1,752	0	56	1,808	917	9	35	961	0.531
1967	1,648	13	173	1,834	677	11	44	732	0.399
1968	1,265	112	339	1,716	556	112	107	775	0.452
1969	2,494	0	0	2,494	1,118	38	0	1,156	0.464
1970	2,382	0	0	2,382	913	34	8	955	0.401
1971	1,788	102	2	1,892	932	102	2	1,036	0.548
1972	1,862	34	36	1,932	1,014	96	25	1,135	0.587
1973	3,192	0	0	3,192	1,550	17	11	1,578	0.494
1974	1,145	0	178	1,323	1,212	186	61	1,459	1.103
1975	1,040	0	5	1,045	1,962	47	25	2,034	1.946
1976	613	0	0	613	2,149	0	22	2,171	3.542
TQ	349	64	0	413	791	52	0	843	2.041
1977	203	51	0	254	1,187	234	57	1,502	5.913
1978	476	0	21	497	2,120	85	60	2,265	4.557
1979	837	0	0	837	3,097	0	48	3,145	3.757
Total	81,846	387	1,635	83,868	32,054	1,187	680	33,921	
43 1/4-year average									0.404

The analysis of the first period involved plotting the costs per cubic yard on semilog paper together with the ENR construction index, which has varied from 235 in 1937 to 3003 in 1979, as shown on figure E-1. When the costs are compared with the general slope of the index, several discontinuities can be recognized: 1937, the years from 1938 to about 1946, the period from 1946 to 1962, and the period from 1963 to 1973. Dredging costs during 1937 were higher than those in the next few years because a significant part of the dredging was done by the less efficient suction-head, pipeline dredges. From 1938 until about 1945, the Thompson operated at near peak efficiency using four crews during much of the dredging season with an average material face of 3.5 to 5.0 feet. From 1946 through 1962, the upward trend of dredging costs per cubic yard was well above that of the preceding years, with the exception of 1937, and above those in the following years. The average annual dredged material face reduced from over 3.5 feet to a low of 2.5 feet while the need for dredging was decreasing. Beginning in 1956, the District was able to reduce dredging costs by using the Thompson, first on the Ohio River and later regularly on the 9-foot channel in the Rock Island District.

Curves (A), (B), and (C) were drawn on figure E-1 roughly parallel to the slope of the index to accommodate the major changes in dredging procedures and obtain a record reasonably consistent with the ENR construction index. Costs per cubic yard for the years covered by curves (B) and (C) were then adjusted downward by 35 and 20 percent, respectively. This procedure maintains the relation between unit costs and quantities dredged while minimizing the tendency of the index multiplier to increase departures from the norm in the earlier years of the period. The results of this adjustment are given in table E-2.

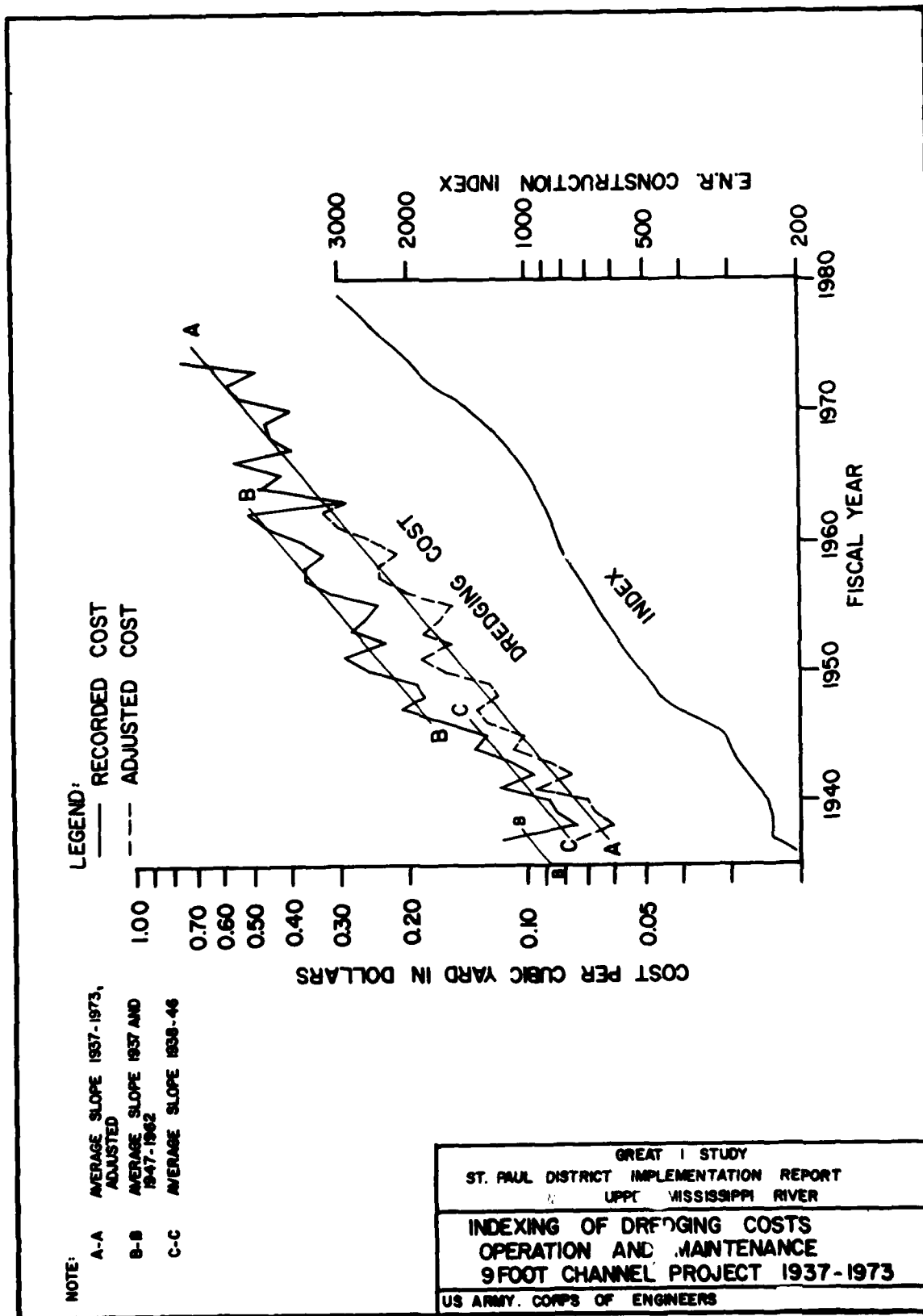


Table E-2 - Adjustment of dredging costs to 1979 price levels for period,  
1937 through 1973

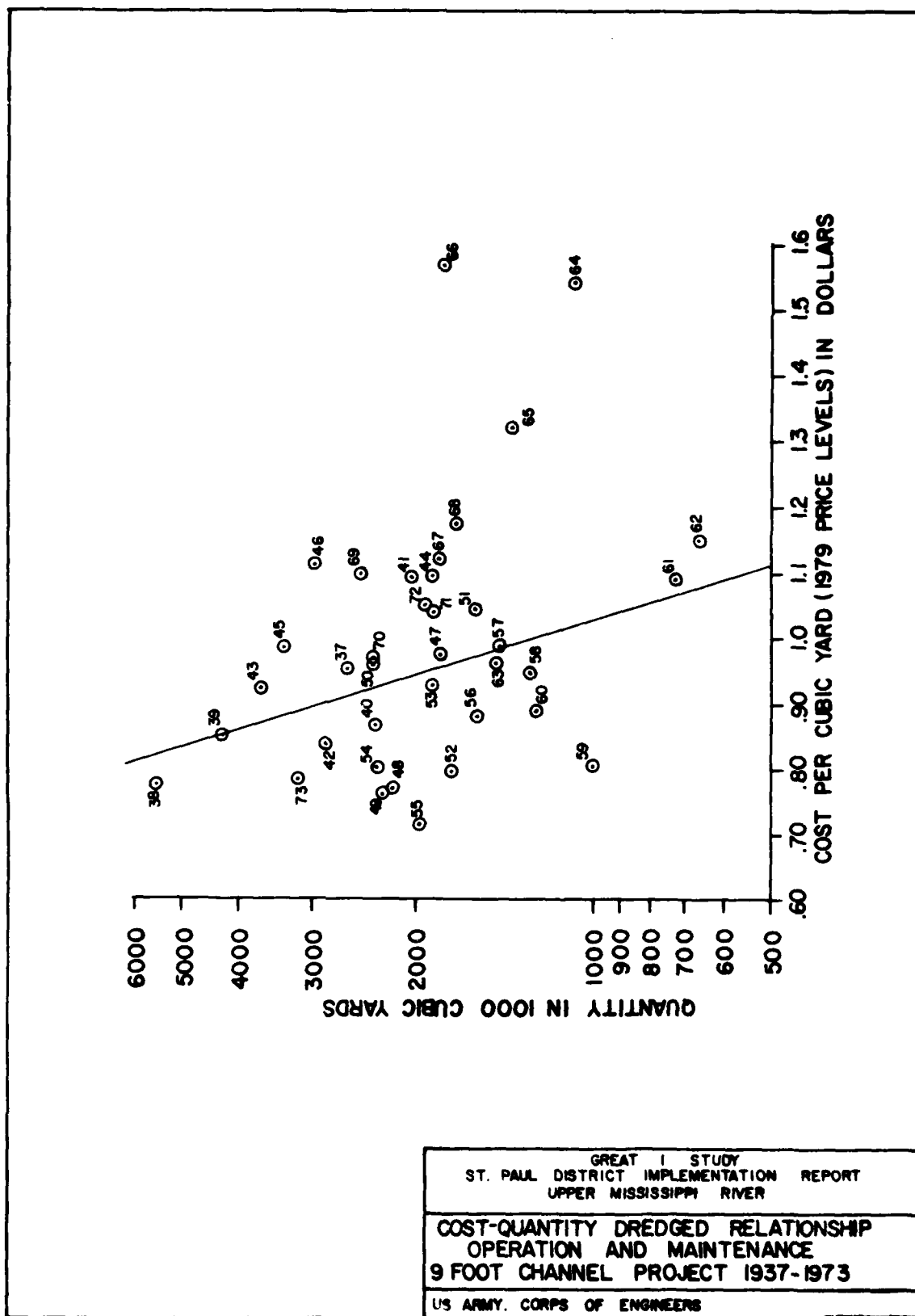
Fiscal year	Quantity dredged (1,000 cubic yards)	Cost per cubic yard (\$)	Uniform adjust- ment (1) (percent)	Adjusted cost per cubic yard (\$)	ENR con- struction index (1979 = 1.00)	Cost per cubic yard(2) (\$)
1937	2,614	0.116	65	0.075	12.779	0.958
1938	5,505	0.076	80	0.061	12.724	0.776
1939	4,251	0.084	80	0.067	12.724	0.853
1940	2,362	0.088	80	0.070	12.409	0.869
1941	2,033	0.119	80	0.095	11.639	1.106
1942	2,841	0.096	80	0.077	10.880	0.838
1943	3,682	0.111	80	0.089	10.355	0.922
1944	1,885	0.136	80	0.109	10.043	1.095
1945	3,347	0.126	80	0.101	9.750	0.985
1946	2,992	0.160	80	0.128	8.679	1.111
1947	1,808	0.207	65	0.135	7.271	0.982
1948	2,200	0.181	65	0.118	6.514	0.769
1949	2,279	0.191	65	0.124	6.295	0.781
1950	2,383	0.251	65	0.163	5.888	0.960
1951	1,596	0.291	65	0.189	5.530	1.045
1952	1,746	0.233	65	0.151	5.278	0.797
1953	1,885	0.285	65	0.185	5.005	0.926
1954	2,353	0.258	65	0.168	4.782	0.803
1955	1,982	0.241	65	0.157	4.550	0.714
1956	1,592	0.313	65	0.203	4.340	0.881
1957	1,430	0.366	65	0.238	4.138	0.985
1958	1,289	0.369	65	0.240	3.956	0.949
1959	1,005	0.330	65	0.214	3.768	0.806
1960	1,260	0.375	65	0.244	3.644	0.889
1961	713	0.459	65	0.298	3.545	1.056
1962	665	0.514	65	0.334	3.444	1.150
1963	1,468	0.289	100	0.289	3.333	0.963
1964	1,088	0.480	100	0.480	3.208	1.540
1965	1,382	0.427	100	0.427	3.092	1.320
1966	1,808	0.531	100	0.531	2.947	1.565
1967	1,834	0.399	100	0.399	2.806	1.120
1968	1,716	0.452	100	0.452	2.600	1.175
1969	2,494	0.464	100	0.464	2.366	1.098
1970	2,382	0.401	100	0.401	2.168	0.869
1971	1,892	0.548	100	0.547	1.899	1.039
1972	1,932	0.587	100	0.587	1.713	1.005
1973	3,192	0.494	100	0.494	1.585	0.783
Total	78,886					
Average	2,132					

(1) See discussion of basis for adjustment and plate E-1

(2) Adjusted to 1979 price levels.

Costs per cubic yard adjusted as outlined in the preceding paragraph were then converted to 1979 price levels using the ENR construction cost index which assumes a cost of 100 in the base year 1913 and has varied from 235 in 1937 to 3003 in 1979. Costs per cubic yard at 1979 price levels have been plotted on figure E-2. Although costs show considerable scattering, the average cost per cubic yard decreases as larger quantities are dredged. Outliers, such as those for fiscal years 1964 through 1966, can be expected because in those years large quantities of material were rehandled thus increasing costs without a commensurate increase in dredged quantities. If the added costs of rehandling material were taken into account, the costs would be reduced and the plotting points would fall closer to the group. Considering the many variables involved, the relationship shown is reasonable.

On the basis of the average of the quantity-cost relations, average dredging costs were developed for the period 1937 through 1973 as shown in table E-3. During this period an average annual quantity of 2,132,000 cubic yards was dredged, representing a cost of about \$0.924 per cubic yard and an average annual cost of about \$1,970,000 at 1979 price levels.



E-10

Figure E-2

Table E-3 - Average cost of dredging and surveys at 1979 price levels

Fiscal year	Quantity dredged (1,000 cubic yards)	1979 price levels	
		Average cost per cubic yard <sup>(1)</sup> (\$1)	Average cost (\$1,000)
1937	2,614	0.912	2,380
1938	5,505	0.82	4,510
1939	4,251	0.85	3,610
1940	2,362	0.922	2,180
1941	2,033	0.942	1,920
1942	2,841	0.900	2,560
1943	3,682	0.868	3,200
1944	1,885	0.952	1,790
1945	3,347	0.880	2,950
1946	2,992	0.894	2,670
1947	1,808	0.956	1,730
1948	2,200	0.932	2,050
1949	2,279	0.928	2,110
1950	2,383	0.922	2,200
1951	1,596	0.971	1,550
1952	1,746	0.960	1,680
1953	1,885	0.951	1,790
1954	2,353	0.923	2,170
1955	1,982	0.945	1,870
1956	1,592	0.972	1,550
1957	1,430	0.983	1,410
1958	1,289	0.998	1,290
1959	1,005	1.026	1,030
1960	1,260	0.999	1,260
1961	713	1.068	760
1962	665	1.077	720
1963	1,468	0.981	1,440
1964	1,088	1.017	1,110
1965	1,382	0.988	1,370
1966	1,808	0.956	1,730
1967	1,834	0.953	1,750
1968	1,716	0.962	1,650
1969	2,494	0.916	2,280
1970	2,382	0.922	2,200
1971	1,892	0.951	1,800
1972	1,932	0.948	1,830
1973	3,192	0.887	2,830
Total	78,886	-	72,930
Average	2,132	0.924	1,970

(1) From figure E-2.



### Separation of Costs by Activity

Cost adjustments to 1979 price levels for the period 1974 through 1979 required a detailed examination of the District cost records to identify work items undertaken since 1973 to meet State and Federal water quality and dredged material placement requirements, conduct studies, and carry out other desired actions. These work items have been grouped into nine principal activities as shown in table E-4. The first item is channel dredging and the associated sounding surveys required to determine where dredging is needed. Costs for these items have increased sharply in recent years because of longer pipelines required to reach acceptable placement areas, use of a booster pump for the hydraulic movement of material, and barging material removed by derrick barge over greater distances. Costs of the GREAT I studies, water quality monitoring, sediment measurements, bank protection, and preparation of areas to retain dredged material are shown in separate accounts. Fish and wildlife costs include costs incurred for removing closing dams and constructing notches and other structures in several of the dams to aerate sloughs and back channels closed by the dams. Recreation costs include expenditures for preparing master recreation plans as well as constructing and maintaining public use and access areas. Funds spent on the environmental impact statement in 1974 and 1975 and other miscellaneous work to protect river resource values are included in the natural resources account. During fiscal years 1978 and 1979, costs for GREAT I studies were provided from the General Investigations program and were not charged to maintenance and operation of the river system. However, about \$116,000 in outstanding obligations was paid from carry-over funds in fiscal year 1978 and is shown as an expenditure that year. Costs for these work items are not identified in a separate account in the annual reports of the Chief of Engineers but are included in the three accounts: new work, maintenance and operation, and care.

Table E-4 - Expenditures for dredging and other work on the 9-foot channel  
on the Mississippi, Minnesota and St. Croix Rivers

Item	Expenditures in \$1,000 by fiscal year							Total
	1974	1975	1976	TQ	1977	1978	1979	
Channel dredging and surveys	1,459	2,034	2,171	843	1,502	2,265	3,145	13,419
Planning studies	-	228	696	173	733	116	-	1,946
Water quality	-	53	21	6	36	250	88	454
Sediment management	17	-	51	7	72	890	350	1,387
Fish and wildlife	102	52	71	-	129	357	5	716
Recreation	24	6	117	35	135	259	130	706
Public education, safety, and sanitation	3	-	10	-	10	-	-	23
Natural resources	435	237	55	21	55	19	28	850
Traffic manage- ment and control	-	1	27	48	41	11	3	131
Total dredging and other work	2,040	2,611	3,219	1,133	2,713	4,167	3,749	19,632

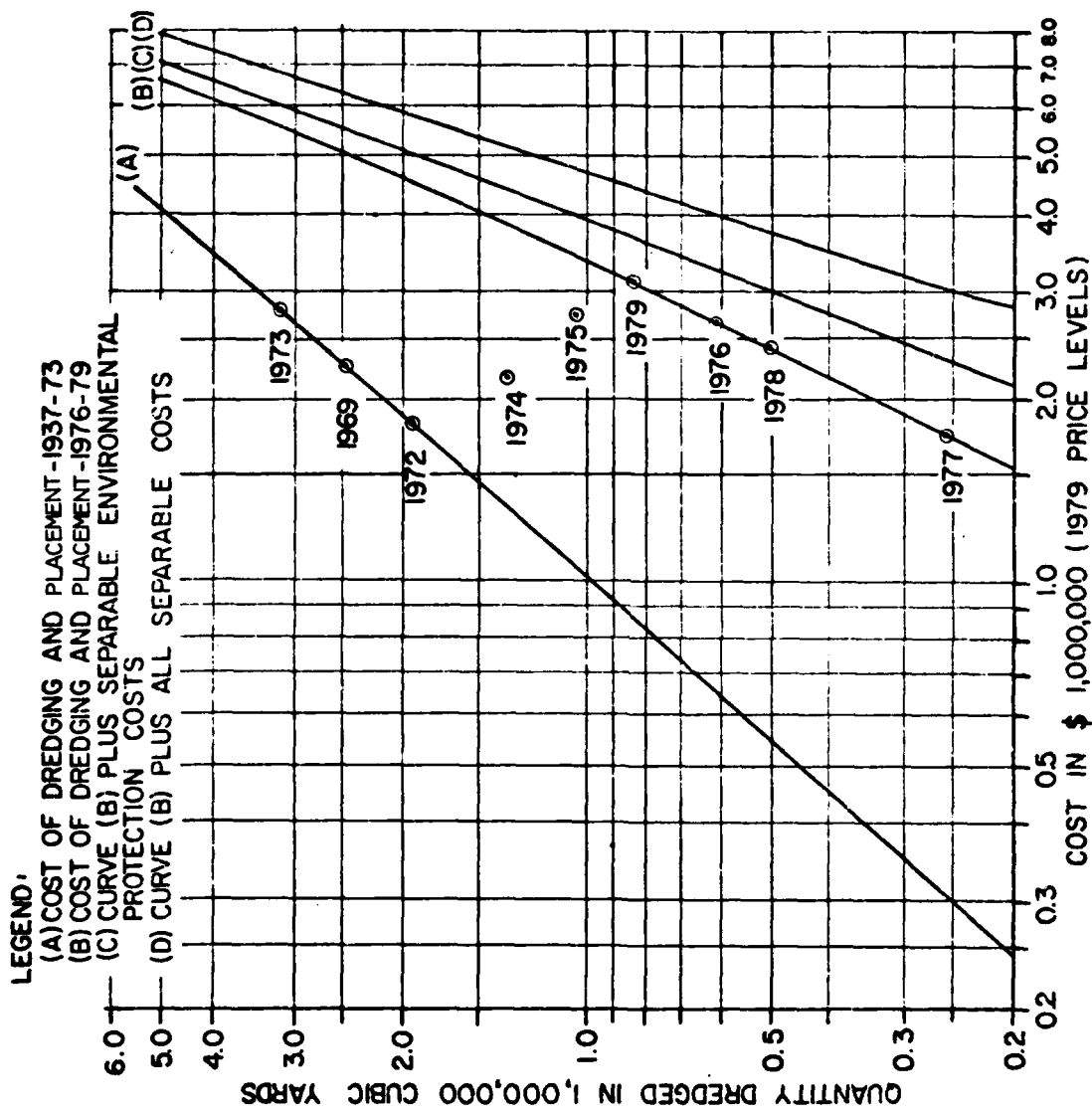
The ENR construction index for the period from 1974 through 1979 is considered to reliably reflect the change in dredging and other costs. Therefore, these costs were adjusted to 1979 price levels using the ENR index as shown in table E-5. During the 6 1/4-year period, expenditures for activities other than those directly related to dredging and placement averaged about 32 percent of the total costs and reached a maximum of about 45 percent in 1977 and 1978. In 1979, other related costs dropped to less than 10 percent of the total river management costs primarily because the GREAT study and report preparation costs were funded from the General Investigations account and less was spent on rehandling dredged material and constructing containment works. These other costs vary significantly from year to year, but for the next few years may approximate \$1.2 million per year, depending on budget limits and continued support and justification for the studies and environmental protection. Of this amount, about \$560,000 per year appears probable for environmental protection actions required to meet Federal water quality standards and State requirements.

Annual dredging and placement costs at 1979 price levels are shown on figure E-3 for two periods: 1937-1973 and 1974-1979. Use of the logarithmic scale brings the costs from 1976 through 1979 into a fairly good straight-line relation. Years 1974 and 1975 clearly represent a transition period during which dredging procedures were being modified to comply with new legislative restraints and accommodate the concerns for protection of natural resources. Because of the relatively low dredging requirements and reduced-depth dredging practices in recent years, dredging and other associated costs provide firm data only in the range between 250,000 and 1,000,000 cubic yards per year. Nevertheless, the trend is clear and the cost experience of recent years can be extended to about 4,000,000 cubic yards per year with some reliability.

Table E-5 - Adjustment of dredging and other costs to 1979 price levels  
for the period, 1974-1979

Fiscal year	Quantity dredged (1,000 cubic yards)	Recorded cost in \$1,000		Index (1)	Cost at 1979 price levels (\$1,000)		
		Dredging and surveys	Other		Dredging and surveys	Other	Total
1974	1,323	1,459	581	1.487	2,169	864	3,033
1975	1,045	2,034	577	1.358	2,762	784	3,546
1976	613	2,171	1,048	1.251	2,716	1,311	4,027
TQ	413	843	290	1.228	1,035	356	1,391
1977	254	1,502	1,211	1.165	1,750	1,411	3,161
1978	497	2,265	1,902	1.082	2,451	2,058	4,509
1979	837	3,145	604	1.000	3,145	604	3,749
Total	4,982	13,419	6,213	-	16,028	7,388	23,416
Average	797						3,747

(1) Based on the average ENR construction index of 3003 in 1979 varying to 2020 in 1974.



GREAT I STUDY  
ST. PAUL DISTRICT IMPLEMENTATION REPORT  
UPPER MISSISSIPPI RIVER

COST-QUANTITY DREDGED RELATIONSHIP  
OPERATION AND MAINTENANCE  
9 FOOT CHANNEL PROJECT - GREAT I AREA  
US ARMY, CORPS OF ENGINEERS

The increased costs of dredging and placement since 1975 are not attributable to increased quantities of material handled. In fact, the quantity dredged averaged about 2,100,000 cubic yards per year from 1969 through 1973 compared to only 800,000 cubic yards per year in the following 5 1/4 years. Thus, although three times as much material was removed from the channel during the first period, the average cost of dredging and placement was only half as much. This reduction in dredging quantities during the last few years has been due, in part, to the lack of any significant floods on the Mississippi River or the principal sediment-contributing tributaries. Another factor has been the change during the last few years to reduced-overdepth dredging and lesser width at some bends.

#### Summary of Experienced Costs

Table E-6 summarizes project maintenance and operation costs, as reported in the annual reports of the Chief of Engineers, adjusted to 1979 price levels. Channel dredging and survey costs from 1937 through 1973 were adjusted to 1979 price levels as discussed earlier and summarized in table E-3. Costs for 1974 through 1979 are from table E-5, except for the 1976 TQ costs which have been adjusted to agree with curve (B) on figure E-3. Other channel maintenance, lock and dam operation and care, and other lock and dam maintenance costs were converted to 1979 price levels by ENR construction index. Initial costs are those reported in the annual reports of the Chief of Engineers. Figure E-4 shows the quantities dredged and annual costs for channel maintenance, operation and care of the locks and dams, and the total. Costs not included are those for new work and major rehabilitation. New work items include the planning and construction of recreation public-use areas, small-boat harbors, and similar project associated features. During the last 12 years, these costs have averaged about \$122,000 per year. The work is normally justified by the public use benefits realized. Major rehabilitation covers costs of repairs to one of the locks at locks and dam 1 at Minneapolis, the overall cost of which was estimated at \$32.5 million at October 1979 price levels and \$37 million at October 1980 price levels. Costs of about \$2.3 million for planning for other possible alternatives, including a new lock and dam downstream from the present site, were included in the operation and care account in the 4-year period before fiscal year 1978. Lock and dam rehabilitation costs are justified by an appropriate share of the savings in commercial transportation costs.

Table E-6 - Summary of average annual project maintenance and operation costs

Fiscal Year	Costs in \$1,000 at prevailing price levels				ENR construction index (1979 = 1.00)				Costs in \$1,000 at 1979 price levels			
	Channel maintenance		L/D maintenance		Channel maintenance		L/D maintenance		Channel maintenance		L/D maintenance	
	Quantity dredged (cubic yards)	Other surveys	Operation and maintenance	Total	Quantity dredged (cubic yards)	Other surveys	Operation and maintenance	Total	Quantity dredged (cubic yards)	Other surveys	Operation and maintenance	Total
1937	2,614	304	372	203	575	12,779	2,380	869	3,249	2,594	0	2,594
1938	5,505	421	50	471	770	12,724	4,510	636	5,146	3,804	0	3,804
1939	4,251	358	50	408	807	12,724	3,610	636	4,246	5,077	0	5,077
1940	2,362	209	55	264	708	12,409	2,180	632	2,862	5,510	0	5,510
1941	2,033	241	27	268	716	11,639	1,920	314	2,234	5,214	0	5,214
1942	2,841	272	34	306	754	10,880	2,560	370	2,930	4,874	0	4,874
1943	3,682	409	56	465	967	10,355	3,200	580	3,780	5,198	0	5,198
1944	1,885	257	25	282	798	10,043	1,790	251	2,041	5,182	0	5,182
1945	3,347	422	26	448	953	9,750	2,950	254	3,204	4,924	0	4,924
1946	2,992	478	42	520	1,105	8,679	2,670	364	3,034	5,077	0	5,077
1947	1,808	374	36	410	1,104	7,271	1,730	262	1,992	4,319	0	4,319
1948	2,200	399	10	409	1,104	6,514	2,050	65	2,115	5,237	0	5,237
1949	2,279	435	4	439	1,104	6,295	2,110	25	2,135	5,603	2,033	7,636
1950	2,383	598	23	621	1,829	5,888	2,200	135	2,335	5,216	1,897	7,113
1951	1,596	464	10	474	1,603	5,530	1,550	55	1,605	5,502	741	6,243
1952	1,746	406	6	412	1,369	5,278	1,680	32	1,712	5,051	0	5,051
1953	1,885	538	5	543	1,800	5,005	1,790	25	1,815	5,471	820	6,291
1954	2,353	606	25	631	2,301	4,782	2,170	120	2,290	5,485	2,501	7,986
1955	1,982	477	1	478	1,746	4,550	1,870	4	1,874	5,341	428	5,769
1956	1,592	498	12	510	1,755	4,340	1,550	52	1,602	5,403	0	5,403
1957	1,430	524	22	546	2,124	4,138	1,410	91	1,501	5,502	1,028	6,530
1958	1,289	475	9	484	2,042	3,956	1,290	36	1,326	5,503	660	6,163
1959	1,005	332	37	369	1,951	3,768	1,169	139	1,169	5,584	377	5,961
1960	1,260	472	27	499	2,493	3,644	1,260	98	1,358	5,721	1,546	7,267
1961	713	327	50	377	2,145	3,545	760	177	937	5,558	709	6,267
1962	665	342	35	377	2,245	3,444	720	120	840	5,400	1,033	6,433
1963	1,468	424	23	447	2,859	3,333	1,440	77	1,517	5,706	2,333	8,039
1964	1,088	522	41	563	2,917	3,208	1,110	132	1,242	5,627	1,925	7,552
1965	1,382	590	29	619	2,870	3,092	1,370	90	1,460	5,652	1,308	6,960
1966	1,808	961	50	1,011	4,011	2,947	1,730	147	1,877	6,103	2,738	8,841
1967	1,834	732	22	754	3,338	2,806	1,750	62	1,812	5,690	1,560	7,250
1968	1,716	775	56	831	3,689	2,600	1,650	146	1,796	5,520	1,911	7,431
1969	2,494	1,156	0	1,156	3,951	2,366	2,280	0	2,280	5,513	1,100	6,613
1970	2,382	955	0	955	3,650	2,168	2,200	0	2,200	5,639	204	5,843
1971	1,892	1,036	0	1,036	4,100	1,899	1,800	0	1,800	5,378	440	5,818
1972	1,932	1,135	108	1,243	4,936	1,713	1,830	125	2,015	5,476	850	6,326
1973	3,192	1,578	111	1,689	5,579	1,585	2,830	176	3,006	5,265	900	6,165
1974	1,323	1,459	581	2,040	6,697	1,487	2,169	864	3,033	5,058	1,866	6,924
1975	1,045	2,034	577	2,611	8,703	1,358	2,762	784	3,544	5,444	9,605	8,773
1976	613	2,171	1,048	3,219	9,619	1,251	2,716	1,311	4,027	5,442	2,564	8,006
1977	413	843	290	1,133	3,624	1,228	2,230	356	2,586	1,616	1,643	3,059
1978	254	1,502	1,211	2,713	10,693	1,165	1,750	1,411	3,161	5,033	4,264	9,297
1979	497	2,265	1,902	4,167	13,870	1,082	2,451	2,058	4,509	5,660	4,838	10,498
1979	837	3,145	604	3,749	12,230	1,000	3,145	604	3,749	5,583	2,898	8,481
Total	83,868	33,921	7,398	41,319	144,761	90,153	14,795	104,948	228,779	49,720	278,499	383,447
Average 43 1/4 years	1,939	784	171	955	3,347	2,084	342	2,427	5,290	1,149	6,439	8,886

(1) Total for Mississippi, Minnesota, and St. Croix Rivers.

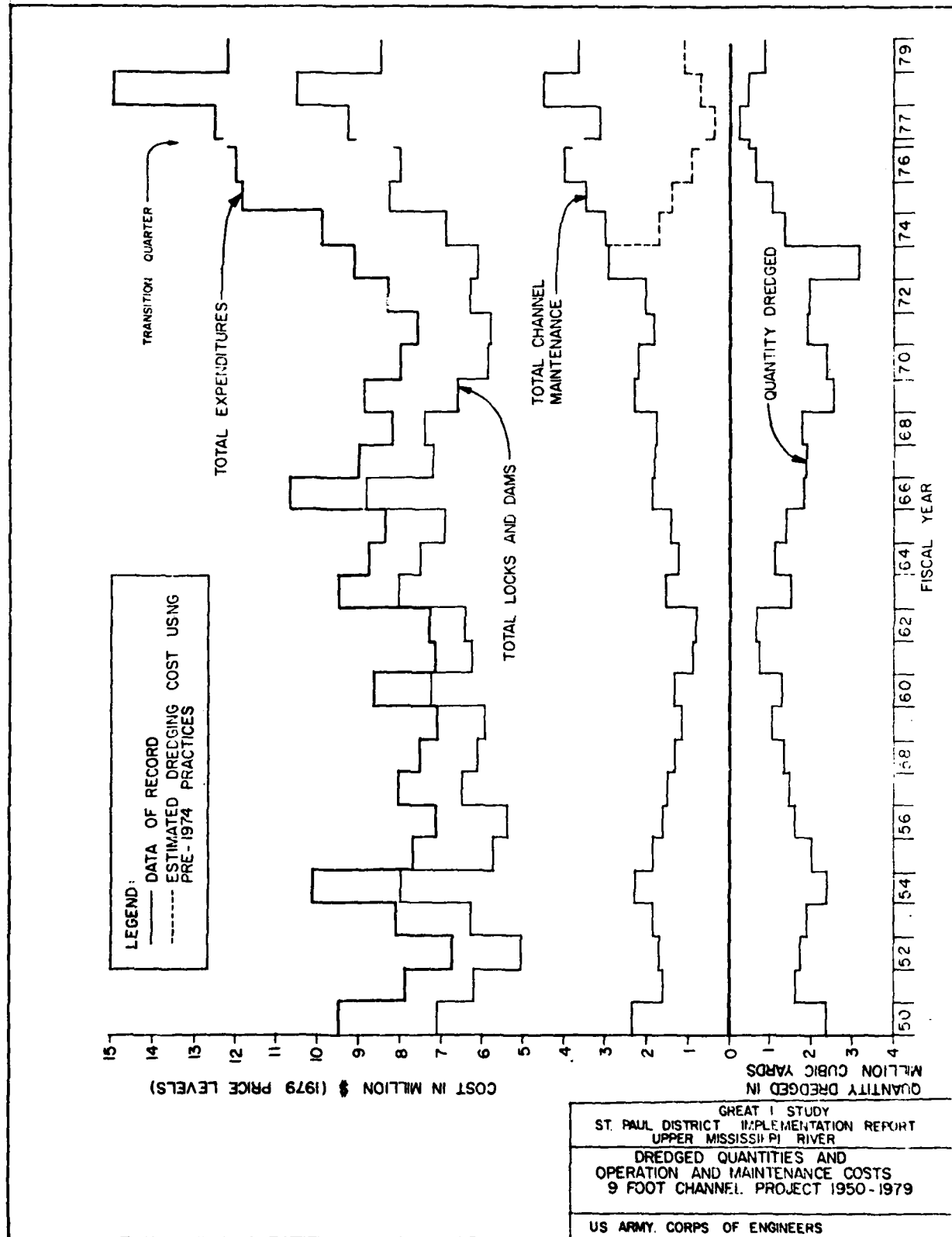




Table E-6 shows that at 1979 price levels costs of dredging and placement have averaged about \$2.08 million over the entire 43 1/4-year period while normal operation and care has averaged about \$5.29 million. Other river-oriented work, including studies and actions which are related to protection of the river environment plus snagging and clearing, have averaged about \$0.34 million. All other structural repairs and miscellaneous study costs have averaged about \$1.15 million. The average cost for maintenance and operation and care of the 9-foot channel project during the period has been about \$8.87 million.

#### Development of Long Term Costs Based on 1974-1979 Experience

In the last 6 1/4 years, project maintenance and operation and care costs at 1979 price levels have considerably exceeded the long-term average. During this recent period, total expenditures increased to about \$12.66 million. Table E-7 provides a summary of the costs by fiscal year, and table E-8 provides a comparison with the long-term averages. In general, the increase in channel dredging and placement costs of \$0.67 million can be explained by the increased length of pipeline and use of a booster pump to transport dredged material over a greater distance. Normal lock and dam operation and care costs did not increase greatly. Also, the increase of about \$0.84 million for additional environmentally related costs was expected, but the increase in the cost of other repairs, studies, and special work of about \$2.16 million requires further consideration. The increase would be due to an accelerating deterioration of the structures or deferred maintenance and studies made possible by the low dredging requirements in recent years. A review of the principal items of work included in the account indicates that the latter is the case. Thus, less than one-third of the recent increase of about \$3.8 million in project maintenance and operation costs is attributable to river resource protection and enhancement.

Table E-7 - Summary of annual project maintenance and operation costs, 1974-1979 (1)							
Fiscal year	Costs at 1979 price levels (\$1,000)						
	Channel dredging and surveys	Lock and dam operation	Total chan- nel and dam maintenance	Environment related actions	Other work		Total operation and maintenance
					Repairs and miscellaneous work	Total other work	
1974	2,169	5,058	7,227	864	1,866	2,730	9,957
1975	2,762	5,668	8,430	784	2,605	3,389	11,819
1976	2,716	5,442	8,158	1,311	2,564	3,875	12,033
TQ	2,230	1,416	3,646	356	1,643	1,999	5,645
1977	1,750	5,033	6,783	1,411	4,264	5,675	12,458
1978	2,451	5,660	8,111	2,058	4,838	6,896	15,007
1979	3,145	5,583	8,728	604	2,898	3,502	12,230
Total	17,223	33,860	51,083	7,388	20,678	28,066	79,149
Average	2,756	5,417	8,173	1,182	3,309	4,491	12,664

(1) Data are from table E-6.

Table E-8 - Comparison of long-term and recent average maintenance and operation costs at 1979 price levels (\$1,000)

Item	Long-term average	1974-1979 average	Average increase
Channel dredging and surveys	2,084	2,756	672
Lock and dam operation and care	5,290	5,417	127
Total	7,374	8,173	799
Environmentally oriented river maintenance studies and actions	342	1,182	840
All other studies, repairs, and special work	1,149	3,309	2,160
Total other work	1,491	4,491	3,000
Total project maintenance and operation	8,865	12,664	3,799

Average annual future maintenance and operation costs are summarized below. The assumption is that costs other than costs for dredging and placement will continue about as experienced during the recent 6 1/4-year period as given in table E-7. Dredging and placement costs are the average of the annual costs obtained from curve (B), figure E-3, for the quantities dredged each year. (See table E-9.)

Channel dredging and placement	\$4,464,000
Normal operation and care of locks and dams	5,417,000
Studies and other costs related to protection and enhancement of river resources	1,182,000
Other special studies and repairs not related to river resource protection and enhancement	<u>3,309,000</u>
Total	14,372,000

#### Impact of Reduced-Depth Dredging

Data presented in table 2 of the Dredging Requirements Appendix of the GREAT I report indicate that dredging requirements have been reduced during recent years about one-third as a result of reduced-depth dredging from 13 to either 11 or 12 feet. The conclusion is that ". . . reducing the depth to 12 feet would have reduced individual dredging requirements by 25 percent without consideration of impact on frequency of dredging." On the basis of experience, a reduction in average annual dredging quantities of about 25 percent could be expected to continue. However, the reliability of the past few years as a true indication of the future trend is questionable. Nevertheless, the sensitivity of the potential effects of reduced-depth dredging on costs is discussed here to provide a framework for consideration of the technique. Thus, assuming that normal dredging practices would have resulted in handling about 800,000 cubic yards in a particular year, the reduced-depth dredging would reduce the quantity to about 600,000 cubic yards, representing a savings of about \$380,000 as shown on figure E-5. Since the reduction in dredging depth and some lesser widths in bends were accomplished during years of less than 1.0 million cubic yards of dredging, no assurance exists that the same reduction could be realized in years of greater required dredging. In years requiring dredging of

2 to 3 million cubic yards, the gains in reduced-depth dredging might be offset by earlier filling requiring redredging at some sites which would not have been necessary if the greater depths had been dredged during the first trip to the site. Nevertheless, assuming that the 25-percent reduction in dredging quantities would be obtainable for years involving handling about 2.8 million cubic yards, a reduction in dredged quantity to about 2.1 million cubic yards and a savings of about \$600,000 might be realized as also shown on figure E-5.

Table E-9 shows that over the 43 1/4-year period of analysis, using the cost experience of the last 6 1/4 years and 1979 price levels, the average annual cost would be about \$4,464,000 without reduced-depth dredging and only \$3,932,000 with reduced-depth dredging. Dredging quantities would be reduced from about 1,978,000 to 1,483,000 cubic yards, respectively. On this basis, reduced-depth dredging would result in a savings of about \$533,000. However, costs would increase from \$2.26 to \$2.65 per cubic yard dredged because of the lower efficiency from dredging smaller quantities each year. A comparison of the changes in average annual dredging costs from those experienced to the costs expected with reduced-depth dredging is summarized in table E-10.

The savings in dredging costs through reduced-depth dredging of about \$533,000, although several times less than the recent increases in dredging and placement costs, are significant. Also, further savings could be realized through a reduction in the rate of filling placement sites, thus extending the period before more distant placement sites with increased transportation costs would have to be used. Conversely, if the lesser depths are not self-sustaining, additional costs might be incurred by commercial traffic through vessel groundings, delays, and possible equipment damages augmented by the costs of redredging. Additional experience during periods of greater dredging requirements is needed before sound conclusions can be reached on the overall value of reduced-depth dredging.

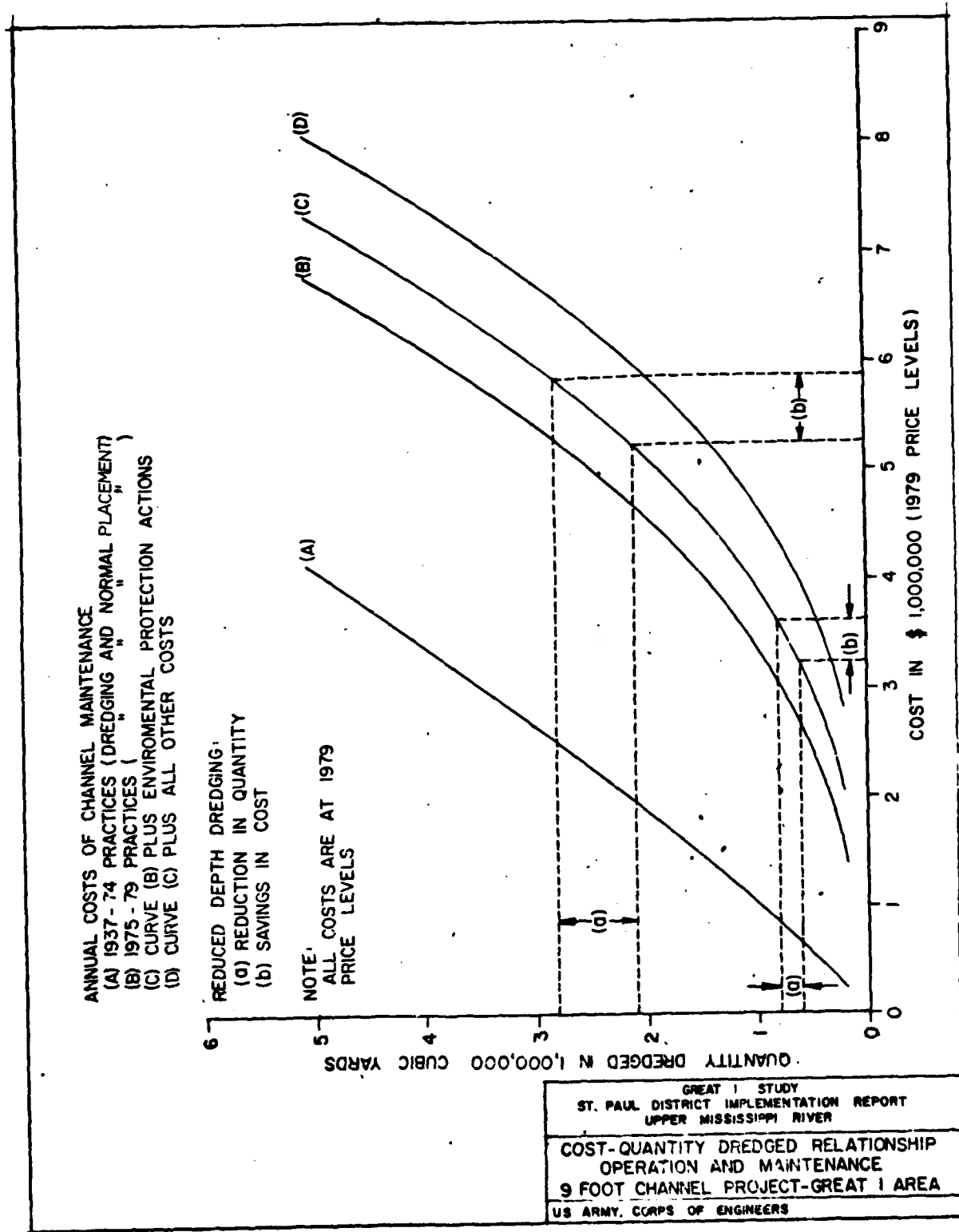


Table E-9 - Average annual dredging costs at 1979 price levels  
with current dredging practices (\$1,000)

Fiscal year	Quantity (1,000 cubic yards) (1)		Dredging cost (\$1,000) (2)	
	Without re- duced depth dredging	With reduced depth dredging	Without re- duced depth dredging	With reduced depth dredging
1937	2,614	1,961	5,160	4,560
1938	5,505	4,129	7,060	6,230
1939	4,251	3,188	6,310	5,600
1940	2,362	1,772	4,940	4,370
1941	2,033	1,525	4,630	4,100
1942	2,841	2,131	5,340	4,730
1943	3,682	2,761	5,940	5,270
1944	1,885	1,414	4,490	3,960
1945	3,347	2,510	5,720	5,070
1946	2,992	2,244	5,450	4,840
1947	1,808	1,356	4,410	3,890
1948	2,200	1,650	4,800	4,230
1949	2,279	1,709	4,870	4,310
1950	2,383	1,787	4,960	4,380
1951	1,596	1,197	4,180	3,680
1952	1,746	1,309	4,340	3,820
1953	1,885	1,414	4,490	3,960
1954	2,353	1,765	4,930	4,360
1955	1,982	1,486	4,590	4,050
1956	1,592	1,194	4,170	3,680
1957	1,430	1,072	4,000	3,500
1958	1,280	967	3,800	3,340
1959	1,000	754	3,400	2,980
1960	1,260	945	3,760	3,320
1961	713	535	2,910	2,520
1962	665	499	2,800	2,200
1963	1,468	1,101	4,020	3,540
1964	1,088	816	3,520	3,100
1965	1,382	1,036	3,910	3,450
1966	1,808	1,356	4,410	3,880
1967	1,834	1,376	4,440	3,910
1968	1,716	1,287	4,310	3,800
1969	2,494	1,870	5,060	4,480
1970	2,382	1,786	4,970	4,300
1971	1,892	1,419	4,500	3,700
1972	1,932	1,449	4,530	4,010
1973	3,192	2,394	5,600	4,980
1974	1,764	1,323	4,370	3,840
1975	1,393	1,045	3,920	3,460
1976	817	613	3,100	2,720
TQ	551	413	2,560	2,230
1977	339	254	2,030	1,750
1978	663	497	2,800	2,450
1979	1,116	837	3,560	3,140
Total	85,529	64,146	193,060	170,040
Average	1,978	1,483	4,464	3,932

(1) Based on the assumption that all dredging quantities through 1973 could have been reduced 25 percent by reduced-depth dredging. Quantities since 1973 have been adjusted to reflect no reduced-depth dredging.

(2) Taken from curve (B), figure E-5.

Table E-10 - Summary of average annual dredging costs

Item	Actual dredging experience	Without reduced depth dredging	With reduced depth dredging
Quantity dredged (1,000 cubic yards)	1,939 <sup>(1)</sup>	1,978	1,483
Prevailing price levels			
Average cost (\$1,000)	784	-	-
Cost per cubic yard (\$)	0.40	-	-
1979 price levels			
Average cost (\$1,000)	2,084	4,464	3,932
Cost per cubic yard (\$)	1.07	2.26	2.65

(1) Includes reduced-depth dredging after 1973.

Summary of Project Maintenance and Operation Costs

Average annual channel dredging and handling costs, at 1979 price levels and assuming that some reduction in average dredging quantities will occur (but less than 25 percent), are estimated at \$4,200,000 as a cost midway between the costs developed in table E-9 and summarized in table E-10. Normal annual lock and dam operation and care costs are developed at 1979 price levels in table E-7 and are about \$5,417,000. Other costs, including studies, structural repairs, and river resource protection and enhancement work, total \$1,491,000 as a long-term average but during the period 1974 through 1979 increased to an average of \$4,491,000 as shown in table E-8. Accepting the latter as an indication of continuing future other costs without implementation of the Channel Maintenance Plan (CMP) and other GREAT I recommendations, the average annual future maintenance and operation costs total \$14,108,000 as shown below.

Dredging and placement with reduced-depth dredging	\$4,200,000
Normal operation and care of locks and dams	5,417,000
Studies and other costs related to protection and enhancement of river resources	1,182,000
Other special studies and repairs not related to river resource protection and enhancement	<u>3,309,000</u>
Total	14,108,000



## MAJOR REHABILITATION

Significant and costly maintenance work is classified as major rehabilitation and is funded under the general construction appropriation account so that the required funds do not unduly distort the operation and maintenance budget. Preconstruction planning of major rehabilitation work, however, is funded from operation and maintenance funds. Rehabilitation work is subject to the following conditions:

1. The work consists only of essential rehabilitation and does not include additions or betterments which represent a change in project purpose, size, capacity, or location. Modernization of operating equipment to meet current design standards may be included as part of the program.
2. The estimated cost is \$2 million or more.
3. The work is required to permit the continued use of the project for the authorized purposes.
4. The work is justified as demonstrated in a reconnaissance report.

With the exception of the landward lock at locks and dam 1 where reconstruction and equipment modernization are under way as a major rehabilitation project, the locks and dams and related structures are in good condition. The depths of scour areas have gradually increased below and, to a lesser extent, above the gate sections and along guide walls at several structures. These scour areas do not appear to be stabilizing and, in some areas, are over 50 feet deep. Thus, remedial action in the next few years may be required in the interest of dam safety. Correction of the scour conditions, if programmed on a case-by-case basis, probably would be funded as an operation and maintenance cost. However, this work would be in addition to the normal operation and maintenance work and, for this report, is considered under the rehabilitation account.

Most of the navigation dams are relatively low-head structures with a maximum difference between pool and tail-water elevations of 5.5 to 12.2 feet. The high-head structures at Minneapolis (the upper St. Anthony Falls lock, the lower St. Anthony Falls lock and dam, and locks and dam 1) have heads which vary from about 27 to 50 feet. These higher-head structures may be more vulnerable, but those at St. Anthony Falls are relatively new (built in the 1950's) and locks and dam 1 is being rehabilitated and will soon be in good condition. Nevertheless, a conservative estimate of probable future costs should recognize the possibility of at least one additional major rehabilitation action as a result of unexpected developments at some future date. These and other rehabilitation actions currently programmed or considered reasonably probable are discussed in the following paragraphs.

#### Lower St. Anthony Falls Lock and Dam

Filling operations at the lock caused a vortex to form at the intake port and resulted in a fatal accident in 1974. As a temporary measure, the filling procedure has been modified to reduce the vortex, but the filling time was increased from 8 to 14 minutes. The increased filling time does not cause major delays with the present lockage requirements; however, increased commerce could produce traffic delays or a reduction in filling time with an increase in the safety hazard. Hydraulics model studies have shown that the vortex could be eliminated by modifying the intake, but the estimated cost of \$4 million cannot be justified. An alternative is being considered which could reduce the cost by 50 percent or more. Assuming a first cost of \$2 million at 1979 average price levels and construction in 1984, the present worth (1979) would be \$1,418,000 with an average annual cost of \$104,000 at an interest rate of 7 1/8 percent and an economic life of 50 years.

#### Locks and Dam 1

The approved rehabilitation plan includes reconstruction of the filling and emptying system, modernization of the electric power supply and control system, removal and replacement of deteriorated concrete to sound concrete,

placement of anchors into bedrock to stabilize lock walls, and other miscellaneous work. Funding for the work is scheduled as follows:

<u>Fiscal year</u>	<u>October 1980 price levels (ENR index 3400)</u>	<u>Average 1979 price levels (ENR index 3003)</u>
Through 1979	\$5,320,000	\$5,320,000
1980	12,700,000	11,200,000
1981	14,000,000	12,400,000
1982	4,930,000	4,350,000
Total	36,950,000	33,270,000

The present worth (1979) of the estimated cost at average 1979 price levels is \$30,140,000 representing an average annual cost of \$2,218,000 at an interest rate of 7 1/8 percent and an economic life of 50 years.

#### Lock and Dam 3

Under some flow conditions, a crosscurrent develops on the upstream side of the lock so that downbound tows have difficulty maintaining their approach to the lock entrance. The recommended plan provides for a 1,250-foot rock dike riverward of the lock together with some upstream dredging. The approved estimate at assumed October 1980 price levels is \$2,500,000 representing a cost of \$2,231,000 at average 1979 price levels. Assuming construction in 1983, the present worth (1979) of the expenditure would be \$1,694,000 representing an average annual cost of \$125,000 at an interest rate of 7 1/8 percent and a 50-year economic life.

### Scour at Locks and Dams

A void is known to exist under the downstream lock apron at one of the dams, and other scour holes have been found both upstream and downstream of the dams. In other areas, scour has exposed the piling along the guide walls. Some shifting and settling of walls and backfill areas have also been found at five of the structures. A study of the scour problems together with cost estimates of proposed corrective measures is planned to start soon. Locks and dams 2 through 10 are suspected to need scour control measures. Assuming that corrective actions are recommended and approved, costs might be expected to average about \$1.0 million at each of the nine structures. This work might extend over a 9-year period beginning in 1984. The investment of \$9 million spread uniformly over the period would represent a present worth (1979) of \$6,480,000. The average annual cost at an interest rate of 7 1/8 percent assuming a 50-year economic life would be about \$477,000

### Unidentified Major Structure Rehabilitation

Although the locks and dams are considered structurally sound and expected to function as designed for the next 50 years, experience supports the conclusion that, in addition to the rehabilitation foreseen, one major action may be expected during the economic period. Thus, for this analysis, the assumption is that one major rehabilitation at a cost of about \$30,000,000 at 1979 price levels would be required. If the work were initiated 25 years hence and extended over a 6-year period of uniform annual funding, the present worth (1979) would be about \$4,552,000. The average annual cost at an interest rate of 7 1/8 percent and a 50-year economic life would be about \$335,000

### Summary of Rehabilitation Costs

Estimated average annual rehabilitation costs are summarized as follows:

Lower St. Anthony Falls lock and dam	\$104,000
Locks and dam 1	2,218,000
Lock and dam 3	125,000
Scour at locks and dams 2-10	477,000
Unidentified major rehabilitation	5,000
Total	3,000

## OTHER WORK

### New Work

Expenditures for improvements for public access to and use of the public waters for boating, fishing, and other recreational purposes as well as for small-boat harbors, public parks, and recreational facilities are included in this account. Section 4 of the Flood Control Act of 1944, as amended, authorized the Chief of Engineers to construct, maintain, and operate such improvements at existing water resource development projects. The objective of the recreation resource management activity is to ensure continued use of the project lands, waters, forest, and associated recreational resources by preserving and enhancing the quality of the outdoor recreation potential created by the project for the benefit of present and future generations.

Public access and recreation improvements are constructed and maintained under the general discretionary authority granted by Congress to the Chief of Engineers. Such works must be in accordance with an approved master plan. Each recreation improvement must be supported by public use benefits determined following procedures prescribed by the Water Resources Council in its Principles and Standards for planning water and related land resource improvements.

Federal participation in the construction of small-boat harbors is based on reports covering each harbor or groups of harbors. Each proposed harbor improvement is analyzed separately and may be recommended for construction with Federal assistance if the benefits, determined in accordance with Water Resources Council guidelines, exceed the costs and all local cooperation requirements can be met. Harbor improvements having an estimated cost exceeding \$2 million must be authorized by Congress; others may be undertaken under one of the special authorities granted by Congress to the Chief of Engineers provided funds are available.

Since new work items are normally supported by recreation-use benefits independent of those evaluated in justification of the 9-foot channel project, the costs of such improvements are not included in this analysis.

### Aids to Navigation

The installation and maintenance of primary navigation aids in navigable waterways is the responsibility of the U.S. Coast Guard, Department of Transportation. Although the aids to navigation facilitate the safe movement of both commercial and recreation traffic, costs are considered a part of the river management system covered in this analysis. Estimated annual costs, at 1979 price levels, of this activity above lock and dam 10 are \$250,000.

### Other Associated Project Costs

In addition to the care and operation of the aids to navigation, the U.S. Coast Guard has other responsibilities including the containment and cleanup of oil and chemical spills, small-boat operator education, and other related programs. Also, the States administer substantial permit programs related to use of land and waters along the Mississippi River and its tributaries. Costs associated with these programs are not readily separable into those concerned directly with the commercial use of the river and those to protect the public health and welfare or to preserve and protect the natural resources of the river system. Accordingly, these costs are not included in this evaluation.

### Existing Structures

Locks and dam 1 was placed in operation in 1917 and was followed by locks and dam 2 in 1930. In the period from 1935 through 1938, locks and dams 3 through 10 opened for traffic and in 1948 the landward lock at locks and dam 2 was readied for passage of commercial and other traffic. The last structures in the system, the upper lock and the lower lock and dam at St. Anthony Falls, were made operative in 1963. Of these structures only locks and dam 1 has served out its assumed economic life of 50 years. This analysis recognizes that an increment of the cost of the other structures remains to be accounted for and supported by the benefits yet to be realized. The present (1979) worth of these remaining annual costs at the average interest of 3 percent prevailing when

the structures were built and the remaining annual costs have been developed as shown in table E-11. The first cost of the structures totals \$87,150,000, and, primarily because of the relatively higher cost of the St. Anthony Falls structures and longer remaining economic life, have a present worth of about \$40,923,000. The average annual value of this remaining amount spread over the 50-year period of analysis at the 3-percent interest rate is estimated at \$1,590,000. This remaining portion of the annual costs of the existing structures represents the financial load remaining which should be included with estimated future rehabilitation costs and average annual continuing costs of maintenance and operation.

Table E-11 - Remaining economic value of existing structures

L/D number	Year put in opera- tion	First cost 1939 (\$1,000)	Annual cost, interest and amortization at 3 percent for 50 years (0.03886) (\$1,000)	Remaining economic life years 1979 base	Present worth of \$1 per year at 3 percent (\$)	Present worth of remaining economic life (\$1,000)	Remaining annual cost at 3 percent for 50 years (0.03886) (\$1,000)
USAF	1963	31,748	1,234	34	21.132	26,077	1,013
LSAF							
1	1917	1,000	39	0	-	0	-
2	1930	2,197	85	1	0.970	82	3
Land- ward lock	1948	4,295	167	19	14.324	2,392	93
3	1938	5,616	218	9	7.786	1,697	66
4	1935	4,865	189	6	5.417	1,024	40
5	1935	5,080	197	6	5.417	1,067	41
5A	1936	4,549	177	7	6.230	1,103	43
6	1936	4,874	189	7	6.230	1,177	46
7	1937	5,574	217	8	7.020	1,523	59
8	1937	6,061	236	8	7.020	1,657	64
9	1938	6,541	254	9	7.786	1,978	77
10	1936	4,750	184	7	6.230	1,146	45
Total		87,150	3,386			40,923	1,590

# SUMMARY OF FUTURE PROJECT COSTS (WITHOUT GREAT I)

Costs considered properly chargeable to the operation and maintenance of the 9-foot channel, as estimated in the foregoing paragraphs, are summarized in table E-12. With the exception of the costs of the existing structures, costs are based on 1979 price levels, and average annual costs are either the average of recurring annual costs or are the interest and amortization of the present worth of ongoing or anticipated future investments. Whereas the 9-foot channel project structures and other facilities might serve their intended purpose a much longer period, an economic life of 50 years is assumed for this analysis. An interest rate of 7 1/8 percent is used as currently specified by the Water Resources Council. Maintenance and operation costs are those expected assuming that dredging practices followed during the period from 1974 through 1979 will be, on the average, about the same and studies and environmental actions will average about \$1.2 million per year.

Table E-12 - Summary of project costs		
Item	Total first cost	Average annual cost
Project maintenance and operation	-	\$14,108,000
Major rehabilitation	\$77,231,000 <sup>(1)</sup>	3,259,000 <sup>(3)</sup>
Aids to navigation	-	250,000
Existing structures	<u>87,150,000<sup>(2)</sup></u>	<u>1,590,000<sup>(4)</sup></u>
Total	164,381,000	19,207,000

(1) 1979 price levels.

(2) Price levels at time of construction.

(3) Based on present worth of future cost, using an interest rate of 7 1/8 percent and a 50-year economic period.

(4) Based on present worth of remaining annual cost at 3 percent spread over the 50-year economic period.

The present worth of the remaining average annual costs of the locks and dams amortized for the 50-year period of this analysis has been determined at the average interest rate of 3 percent in effect when the locks and dams were constructed. Estimated average annual costs total \$19,207,000.



## BENEFITS

### EVALUATION PROCEDURE

The evaluation of navigation benefits is in general accordance with Section 7(a) of the Department of Transportation Act of 1966 (Public Law 89-670). However, the work predates the benefit evaluation procedures published by the Water Resources Council in the Federal Register, 14 December 1979. Consequently, some steps may be different and lead to different statistical results. However, the benefit analysis applies the same underlying principles of transportation economics. The guidelines provide for measuring the beneficial contributions of water resource projects to national economic development. These benefits include an estimate of savings to shippers using or expected to use the waterway, measured as the product of the waterway traffic and the estimated unit savings to shippers from use of the waterway. In this particular case, the unit savings are measured as the difference between the rates shippers are paying for movement of commodities on the 9-foot channel and connecting waterways and the rates they would pay via the least cost available alternative mode of transportation. The benefits of the waterway to the national economy are the savings in resources from not having to use a more costly transportation mode.

### WATERBORNE COMMERCE

Waterway traffic reports display data for most commodities moved on the river systems grouped under 11 principal headings as shown in table E-13. Those commodities that are not moved by water in the District and others that move in relatively small amounts have been combined under six principal headings: coal, petroleum and petroleum products, chemicals, metal products and metal scrap, farm products (chiefly grain), and nonmetallic minerals (including sand and cement).

Table E-13 - Commodity codes for the waterway traffic report

Code	Description	Code	Description
01	Empty barges	50	Nonmetallic minerals, except fuels <sup>(1)</sup>
10	Coal <sup>(1)</sup>	51	Limestone flux and calcareous stone
11	Coal and lignite	52	Sand, gravel, and crushed rock
20	Petroleum and petroleum products <sup>(1)</sup>	53	Phosphate rock
21	Crude petroleum	54	Sulphur, liquid and dry
22	Gasoline	55	Salt
23	Jet fuel and kerosene	60	Stone, clay, glass, and concrete <sup>(1)</sup>
24	Distillate fuel oil	61	Building cement
25	Residual fuel oil	62	Lime
26	Coke (coal and petroleum), petroleum pitches, asphalts, naphtha, and solvents	70	Fresh fish and other marine products <sup>(1)</sup>
30	Chemicals and related products <sup>(1)</sup>	71	Marine shells, unmanufactured
31	Organic industrial chemicals (crude products from coal tar, petroleum, and natural gas, dyes, organic pigment, dyeing and tanning materials, alcohols, benzene)	80	Farm products <sup>(1)</sup>
32	Synthetics (plastic materials, synthetic rubber, synthetic fiber) —	81	Corn
33	Drugs, soap, detergent and cleaning preparations, paints, gum and wood chemicals, radio-active and associated materials	82	Wheat
34	Inorganic industrial chemicals (sodium hydroxide)	83	Soybeans
35	Nitrogenous chemical fertilizers (anhydrous ammonia)	84	Oats
36	Potassic chemical fertilizers	85	Barley
37	Phosphatic chemical fertilizers	86	Rye
38	Other basic chemicals and basic chemical products	87	Flaxweed
39	Other fertilizers	88	Flour
40	Metallic ores, metal products (primary and fabricated), waste and scrap materials <sup>(1)</sup>	89	Vegetable products
41	Metallic ores	90	Miscellaneous products
42	Iron ore	91	Forest products
43	Primary iron and steel products	92	Lumber and wood products
44	Other primary metal products	93	Pulp, paper, and allied products
45	Fabricated metal products	94	Processed agricultural products (including food and kindred products and tobacco products)
46	Waste and scrap materials	95	All manufactured equipment and machinery including ordnance and accessories, machinery, electrical machinery, transportation equipment, instruments, photographic and optical goods, watches and clocks, and miscellaneous products of manufacturing)
		99	Commodity is "unknown" or cannot be located on this list.

(1) Either not classified within this general category or a more detailed classification is unknown.

### Available Records

Annual reports of commodity movements in the St. Paul District are available from three sources:

1. Preliminary summaries of barge traffic compiled monthly by the District for the period 1935 through 1976.
2. The Performance Monitoring System (PMS).
3. Shipments and receipts compiled by the Waterborne Commerce Statistical Center (WCSC).

The District record, which was prepared manually, and other lockage records are now included in the PMS computerized data bank. The District reports provided data on shipments and receipts under the general headings of coal, burner oils, gasoline, and a total of all receipts together with shipments of grain, coal (in 1975 and 1976), and a total of all shipments. Shipments and receipts were shown as a total for all ports in the District with separate listings for Minneapolis and St. Paul, Minnesota. These reports served a need for provisional data not always obtainable from the statistical center when needed.

The PMS data are stored in a computer bank and can be recalled readily. Data include the number and types of craft, numbers of barges moved on the river both loaded and empty, and commodity movements by the principal commodity codes used in the traffic reports. The advantage of the system is the ready access and availability of up-to-date information. The system has the disadvantage of being based on lockage records which do not include intrapool commodity movements. About three-fourths of the shipments of refined petroleum products and sand and gravel from pool 2 terminals south of the Twin Cities move upstream to receiving terminals in St. Paul without passing through a lock. These commodity movements may not be important in some studies concerned with long-haul movements or lock capacities, but they are significant in determining transportation savings.

The WCSC system provides the best source of data for a study of water-borne commerce. Records of all shipments and receipts, by commodity codes and origin and destination, are stored in the data bank and can be recalled for each pool, a specific Corps of Engineers District, or groups of Districts. Currently the WCSC system can provide data only for the period 1970 through 1977. Table E-14 provides a summary of the principal commodity shipments and receipts in the St. Paul District for the 1970-1977 period. Total receipts and shipments of commodities include some duplication when movements are considered on a ton-mile basis. Thus, shipments from one terminal to another within the District are double counted, first as a shipment and then as a receipt. This duplication is eliminated by using only total shipments: those from each District terminal for all destinations on the waterway system and those shipped to District terminals from points outside the District. These modified records are identified in this study as "Adjusted Shipments and Receipts."

Table E-15 shows the shipments from St. Paul District terminals and the shipments from all other terminals to the St. Paul District for 1976, a total of 17,684,000 tons, about 83.7 percent of the total 21,117,000 tons handled by the District terminals.

Table E-14 - Summary of St. Paul District waterborne commerce (WCSC)

Year	Item	Coal	Petroleum and petroleum products	Chemical and related products	Metallic ores	Farm products	Nonmetallic		Grand total
							minerals, in- cluding stone,	Total tonnage	
1970	Shipment	10,872	1,226,789	24,350	25,872	5,635,481	1,679,807	8,603,171	
	Receipts	4,250,856	1,805,417	593,243	58,084	36,103	2,264,259	9,007,962	17,611,133
	Shipment	44,925	1,463,351	18,649	61,113	5,118,431	1,559,619	8,266,088	
1971	Receipts	4,394,930	1,804,317	741,123	109,047	27,752	2,158,556	9,235,725	17,501,813
	Shipment	322,043	1,512,255	26,233	71,906	6,104,213	1,612,624	9,649,274	
	Receipts	5,099,360	1,907,798	641,597	118,530	18,755	2,323,746	10,109,786	19,759,060
1972	Shipment	643,490	1,404,691	6,935	54,430	7,179,310	1,679,293	10,968,149	
	Receipts	3,601,623	1,684,923	593,536	124,764	6,291	2,125,330	8,136,467	19,104,616
	Shipment	1,429,626	1,300,526	1,411	21,649	7,913,447	1,562,544	12,229,203	
1974	Receipts	3,906,122	1,474,291	655,283	115,186	30,105	2,142,618	8,323,605	20,552,808
	Shipment	2,363,339	1,479,156	12,207	37,669	5,679,677	1,179,220	10,751,268	
1975	Receipts	4,836,264	1,623,208	830,123	128,527	30,159	1,923,396	9,371,677	20,122,945
	Shipment	2,308,564	1,333,789	17,642	61,852	6,536,394	1,576,871	11,835,112	
1976	Receipts	4,470,051	1,423,684	896,542	197,048	32,289	2,262,646	9,282,260	21,117,372
	Shipment	2,306,574	1,388,270	25,301	48,451	5,620,015	1,616,048	11,004,659	
1977	Receipts	4,894,553	1,761,709	897,491	254,413	9,134	2,229,617	10,046,917	21,051,576

Table E-15 - Shipments by all terminals to and from the St. Paul District in 1976  
Shipments (1,000 tons)

Origin	Coal	Petroleum products	Chemicals	Metal products and scrap	Farm products	Non-metallic minerals, sand and other	Total
		From St. Paul District terminals					
Minneapolis	1,730	63	18	11	411	201	2,434
St. Paul	545	-	-	8	1,986	159	2,698
Minnesota River	31	-	-	-	2,558	90	2,679
Pool 2	-	1,257	-	-	-	1,577	2,834
St. Croix River	2	-	-	-	-	-	2
Hastings	-	21	-	-	-	-	21
Red Wing	-	-	-	-	337	64	401
Alma	-	-	-	-	-	-	-
Winona	-	2	-	-	439	3	444
La Crosse	-	2	-	5	134	3	144
Genoa	-	-	-	-	-	-	-
Prairie du Chien	-	-	-	-	629	-	629
L/D 10	-	-	-	-	-	-	-
		To St. Paul District terminals					
Rock Island District	2	-	151	-	2	29	184
St. Louis District	1,836	184	21	8	-	217	2,266
Missouri River	-	-	3	-	-	-	3
Illinois River	23	56	3	98	-	12	192
Middle Mississippi River	-	-	53	-	-	-	53
Lower Mississippi River	-	502	596	21	-	170	1,289
Lower Ohio River	580	29	-	3	-	-	612
Upper Ohio River	53	-	14	60	-	-	127
East Gulf	-	192	4	-	-	361	557
West Gulf	14	41	53	-	-	7	115
Total	4,816	2,349	916	214	6,496	2,893	17,684

### Projections of Future Traffic

Estimates of future waterborne commodity movements via the 9-foot channel have generally been ultraconservative, often underestimating traffic by a wide margin. For example, in 1952 the District estimated future annual traffic on the Minnesota River in justification of extending the 9-foot channel from the mouth to mile 14.2 (later extended to mile 14.7) at 200,000 tons of grain, 400,000 tons of coal, and 48,000 tons of petroleum products. In 1976, the shipments and receipts by terminals on the river included 2,558,441 tons of grain, 772,940 tons of coal, and 45,830 tons of petroleum products. In addition, over 400,000 tons of other commodities were moved on the Minnesota River that year. In about 25 years, the traffic increased from about 100,000 tons to 3,777,000 tons and exceeded the District estimate by over 500 percent. This growth in riverborne commercial traffic is reflected in the growing congestion at some locks and the problems associated with the need for additional barge fleeting areas. Recent projections of riverborne traffic in the St. Paul District are summarized in the following paragraphs.

North Central Division Projections. - Two Phase I reports, representing the initial study using only available data to determine if more detailed studies should be made, were completed in the early 1970's by the Corps of Engineers North Central Division and included projections of commodity movements on the Upper Mississippi River from Cairo, Illinois, to Minneapolis and on the Illinois Waterway. The first report, completed September 1972 and revised May 1973, concerned the merits of and need for a 12-foot channel on the waterways. The second report, completed September 1973, considered the feasibility of providing a 12-month navigation season on the Mississippi River above Grafton, Illinois. The reports recommended no further study of a 12-foot channel on the Mississippi River above Grafton or of a 12-month season above Burlington, Iowa. However, both reports included data on existing (1970) and projected water traffic using origin-destination data for 1968 as the base and a system simulation computer model. Traffic estimates through lock and dam 10 presented in the reports are as follows:

<u>Year</u>	<u>Traffic in 1,000 tons</u>
1970	10,900
1980	17,200
1990	18,600
2000	19,100
2010	21,900
2020	24,500
2030	27,600

University of Minnesota Projections. - As a part of the GREAT I study, the Commercial Transportation Work Group arranged for a contract with the University of Minnesota, Department of Agriculture and Applied Economics, for a study of the existing and probable future waterborne commodity movements in the St. Paul District. The resulting report<sup>(1)</sup> presents seven projections to year 1985 based on various assumed changes in movements of the principal commodities being shipped and received by terminals above lock and dam 10. The traffic growth projections were developed from records of commodity movements and average growth rates during the period 1963 through 1976 and are presented for seven possible situations. The record of growth rates and estimated most probable future growth rates were used to develop a 1985 base-line projection on a commodity-by-commodity basis for each pool. The report concludes that the base-line case is most representative of the 1985 commodity movements in the District. The other six situations show the effects of various assumptions of significant changes that might occur in the use of the waterway as a part of the overall transportation system. Thus, situation 1A projects a 50-percent increase in shipments of farm products while situation 1B shows the effect of a 50-percent decline, both representing variations from the base-line 1985 results. Situations 2 and 3 consider alternative coal movements from western and midwestern sources and the probable locations of new coal-burning electricity-generating plants. Situation 4 combines the assumptions of 1A and 2 while situation 5 joins the assumptions of 1A and 3.

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(1) Bulk Commodity Barge Traffic on St. Paul District Waterways in 1985: Projections and Impacts, by Robert A. Hill, Jerry E. Fruin, and Carol Such, Department of Agriculture and Applied Economics, Staff Paper P 78-15, September 1978.



The 1985 projected shipments and receipts by terminals in the St. Paul District are estimated in 1,000 tons as follows:

<u>Situation</u>	<u>Shipments</u>	<u>Receipts</u>	<u>Total</u>
Base line	17,542	10,536	28,078
1A	22,931	10,536	33,467
1B	12,153	10,536	22,689
2	28,958	16,244	45,202
3	17,542	14,816	32,358
4	34,347	16,244	50,591
5	22,931	14,816	37,747

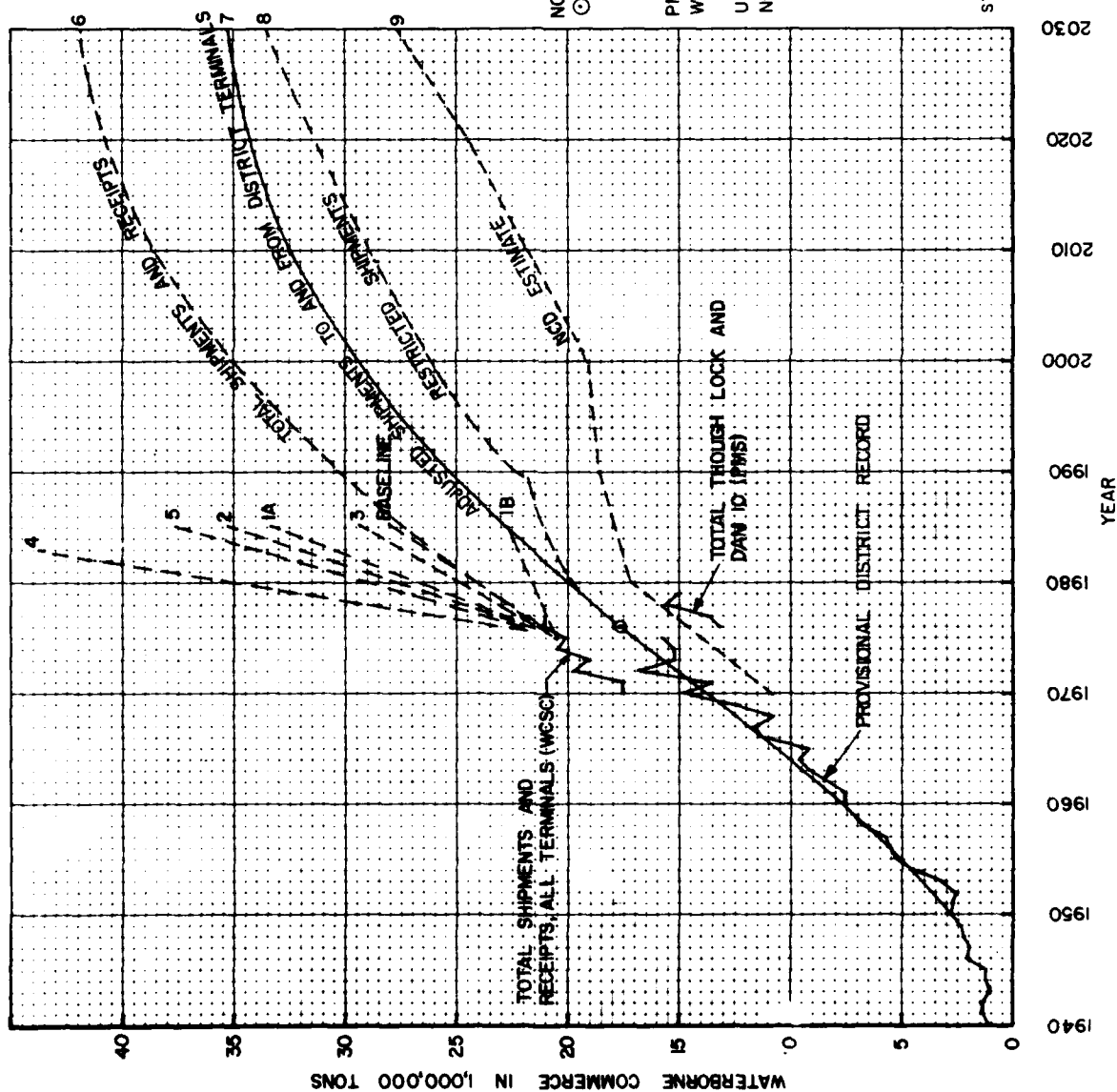
The University of Minnesota study considered the impact of projected estimates of future commercial traffic on the capability of the locks to handle the increased traffic. The study found that the locks were used about 50 percent of the time in 1977 for both commercial and recreation lockages and that projections of commercial shipments to the 35,000,000-ton range would probably increase the use to an average of 75 percent. Some increase in delays at the locks could be expected, and additional pressures for fleeting areas would develop. A disproportionate increase in upbound or downbound traffic could increase movement of empty barges and possibly further increase congestion at the locks. In the St. Paul District, with the exception of locks and dam 1 and the two locks at St. Anthony Falls, recreation lockages approach or exceed the number of commercial lockages. Thus, if delays at the locks become too great, the congestion could be relieved by providing separate facilities for recreation craft. However, preliminary data from a study of the need for independent facilities for passage of recreation craft indicate that the congestion at peak periods of recreation traffic movement could be handled presently and in the near future by developing waiting areas at the locks and alternating the passage of commercial and recreation craft. Thus, at this time, the locks do not appear to offer an insurmountable deterrent to the growth of commercial traffic.

The University of Minnesota study also recognized the problem of supply and demand for bulk commodities moved on the river, the effects of Federal regulations, the mix between upbound midwestern coal and downbound western low-sulfur coal, the OPEC oil embargo of 1973, and the impact of the tax on fuel used to move commodities to and from St. Paul District terminals. None of the foreseeable changes were considered to significantly retard the growth of commercial traffic on the river.

District Projections. - Figure E-6 shows the total shipments and receipts from all District terminals (WCSC record) from 1970 through 1977, the provisional District record from 1940 through 1975, and the record of commercial traffic through lock 10 from the PMS program. Also shown are the University of Minnesota projections to 1985 (base line to curve 5), the North Central Division projection (curve 9), and the District projections (curves 6, 7, and 8). Curve 6 represents a projection of the growth of shipments and receipts over the next 50 years accepting the 1985 base-line growth anticipated in the University of Minnesota study and near zero growth after year 2029. Curve 7 represents an adjustment of curve 6 to eliminate the duplication of commodity movements within the District when both shipments and receipts are considered. In 1976 the adjusted record differed from the total shipments and receipts by 17.3 percent. This difference was assumed to prevail in the future so that points on the adjusted curve are 17.3 percent less than corresponding points on curve 6.

The growth in commodity movements by water to and from terminals on the inland waterway system has already caused relatively long delays at lock and dam 26 near St. Louis where replacement of the existing lock is not expected to be completed until 1987. Thus, continued growth of the traffic which must pass through the lock may be expected to be restricted because of the delay which could grow from several days to weeks before the new lock is in service. The new 1,200-foot lock will eliminate double lockages for most tows and reduce the time for passage of large commercial tows about 50 percent. Nevertheless, current projections of traffic through

lock 26 indicate delays may be expected in about 20 years unless a second lock is provided. Curve 8 on figure E-6 takes into account the slower growth in commodity movements caused by the traffic congestion. All commodity movements which do not have to pass through lock and dam 26 are expected to grow at the unrestricted rate. Commodities which must pass through locks and dam 26 are assumed to increase only 5 percent in the 10-year period after 1979, and 20 percent in the next decade using the new lock. Thereafter, the growth is assumed to be 10 percent for each decade. The development of the traffic projection under restricted conditions is shown in table E-16.



NOTES:  
 © 1976 DISTRICT SHIPMENTS  
 (EXCLUDING RECEIPTS WHICH DUPLICATE  
 SHIPMENTS FROM DISTRICT TERMINALS)

PMS = PERFORMANCE MONITORING SYSTEM  
 WCSC = WATERBORNE COMMERCE STATISTICAL  
 CENTER  
 U of M = UNIVERSITY of MINNESOTA  
 NCD = NORTH CENTRAL DIVISION,  
 CORPS of ENGINEERS

GREAT I STUDY  
 ST PAUL DISTRICT IMPLEMENTATION REPORT  
 UPPER MISSISSIPPI RIVER  
 PROJECTION OF  
 TOTAL WATERBORNE COMMERCE  
 9-FOOT CHANNEL PROJECT  
 U.S. ARMY CORPS OF ENGINEERS



The Inland Waterways Revenue Act of 1978 provides for a tax on fuel used by vessels in commercial transportation on the inland and intracoastal waterways of the United States. All towboats moving commodities to and from St. Paul District terminals are subject to the tax which is scheduled to increase from 4 cents a gallon after 1 October 1980 to 10 cents a gallon after 30 September 1985. The University of Minnesota 1978 study concluded that the user charges up to 8 cents a gallon would be reflected in costs to shippers but would not cause a significant reduction in the growth of barge shipments. In this study of future traffic on the river system, the user tax has not been considered as a factor affecting the expected increase in waterborne commercial traffic.

Curve 7 might best represent the growth pattern with a normal market controlled by supply and demand. However, for this analysis, curve 8 has been selected because it is more conservative and recognizes the probable effects of the growing congestion at locks and dam 26. The estimated future commerce is summarized as follows:

<u>Year</u>	<u>Total commodity movements</u> (in 1,000 tons)
1979	19,450
1989	21,800
1999	25,900
2009	28,600
2019	31,000
2029	33,400

#### TRANSPORTATION SAVINGS

The determination of transportation savings creditable to the St. Paul District portion of the waterway system involves, first, the product of the total volume of each commodity moved and the unit savings per ton. The second step recognizes that the St. Paul District is only part of the waterway system through which the commodities move. In the absence of a detailed system analysis, total transportation savings assigned to the St. Paul District have been based on the ratio of the approximate distance traveled in the St. Paul District to that traversed below lock and dam 10. To facilitate the apportionment of savings, shipping and receiving terminals downstream from the St. Paul District have been grouped on a regional basis. The specific and average mileage relationship is shown in table E-17.

Table E-17 - Distances in miles between average terminal locations on the Inland Water Transportation System

	Minneapolis	Minne- sota River	St. Paul	Pool 2	St. Croix River	Hastings	Wing	Alma	Winona	Crosse	Genoa	Chien	L/D 10
Minneapolis	-												
Minnesota River	22	-											
St. Paul	13	19	-										
Pool 2	22	28	9	-									
St. Croix River	62	68	49	40									
Hastings	38	44	25	16	16								
Red Wing	63	69	50	41	41	25							
Alma	101	107	88	79	79	63	38	-					
Winona	127	133	114	105	105	89	64	26	-				
La Crosse	155	161	142	133	133	117	92	54	28	-			
Genoa	174	180	161	152	152	136	111	73	47	19	-		
Prairie du Chien	218	224	205	196	196	180	155	117	91	63	44	-	
L/D 10	238	244	225	216	216	200	175	137	111	83	64	20	-
Rock Island District	352	358	339	330	330	314	289	251	225	197	178	134	114
St. Louis	672	678	659	650	650	634	609	571	545	517	498	454	434
Illinois River	633	639	620	611	611	595	570	532	506	478	459	415	395
Middle Mississippi R.	1,083	1,089	1,070	1,061	1,061	1,045	1,020	982	956	928	909	865	845
Lower Mississippi River	1,721	1,727	1,708	1,699	1,699	1,683	1,658	1,620	1,594	1,566	1,547	1,503	1,483
Lower Ohio River	1,200	1,206	1,187	1,178	1,178	1,162	1,137	1,099	1,073	1,045	1,026	982	962
Upper Ohio River	1,834	1,840	1,821	1,812	1,812	1,796	1,771	1,733	1,707	1,679	1,660	1,616	1,596
East Gulf	2,000	2,006	1,987	1,978	1,978	1,962	1,937	1,899	1,873	1,845	1,826	1,782	1,762
West Gulf	1,900	1,906	1,887	1,878	1,878	1,862	1,837	1,799	1,773	1,745	1,726	1,682	1,662

### Unit Savings

Transportation savings are the difference in the cost of commodity movements from origin to destination by water and the costs or established rates applicable to moving those commodities by the least-cost alternative mode. Waterway costs include all origin-to-destination costs including those involved in handling, demurrage, and transfers between terminals and transshipment points. Costs by other transportation modes are, in accordance with Section 7a of the 1966 Department of Transportation Act (Public Law 89-670), the prevailing competitive rates when available, or other price data when rates are not established. Rates or other cost data are those which in the judgment of the analyst best represent the applicable costs of competitive commodity movements, and as a result represent a best approximation of the savings in transportation costs obtainable by use of water shipments.

For this study, transportation savings have been based on a rate analysis conducted by the North Central Division for the year-round and the 12-foot channel studies in 1972 and 1973, updated and supplemented by more recent rate studies conducted by the St. Paul District for the locks and dam 1 rehabilitation program. The earlier rate studies were reviewed and brought up to 1978 price levels by the University of Minnesota economists. The rate changes granted for rail movements, cost increases because of oil price changes, and other recent cost increases since the original North Central Division rate study were taken into account in the University of Minnesota analysis. In some cases, when unit savings for small tonnage commodity movements between terminals were not available, savings were determined by interpolation of savings for transfer of like commodities between other nearby terminals for which comparative transportation costs were available.



### Savings on 1979 Traffic

Tables E-18 through E-23 illustrate the procedure followed to develop origin-to-destination savings and the allocation of savings to the St. Paul District on each of the six principal commodity groups for the shipments in 1976 at average 1978 price levels. The results of the detailed analyses are summarized in table E-24 and show a savings credited to the St. Paul District portion of the system of \$21,717,000 out of a total savings of \$102,263,000. Because of the large volume of coal movements between District terminals, about 40.9 percent of the coal savings are allocated to the District whereas only 12.5 percent of the savings on movements of farm products are allocated to the District. On the average for all commodity movements, only 21.2 percent of the total transportation savings are credited to the St. Paul District portion of the system.

The total District transportation savings of \$21,717,000 are based on a 1976 traffic volume of 17,684,000 tons at 1978 average price levels, representing an average savings of \$1.227 per ton. Figure E-6 provides a projection of river commerce in the St. Paul District from 1976 to 1979 when an average movement of about 19,450,000 tons is expected. The adjustment from 1978 to 1979 price levels is based on the assumption that all commodity shipments would increase proportionately and the savings would increase at the same rate as the ENR construction index or about 8.177 percent from \$1.227 to \$1.327 per ton. On this basis the total savings at 1979 price levels would be about \$25,830,000. The development of commodity shipment and savings at 1979 projections and price levels is given in table E-25.

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Table E-18 - Savings on shipments to and from St. Paul District terminals in 1976 - coal

Destination	Quantity (tons)	Savings per ton (\$)	Total savings (\$1,000)	System movement		St. Paul District movement		St. Paul District portion of total ton-miles (percent)	St. Paul District portion of savings (\$1,000)	Savings per gallon of fuel <sup>(1)</sup> (\$)
				Miles	ton-miles	Miles	ton-miles			
Downbound shipments										
From Minneapolis										
Minnesota River	611,885	0.20	122	22	13,461	22	13,461	100.00	122	3.64
St. Croix River	576,404	1.12	646	62	35,737	62	35,737	100.00	646	7.23
Alma	168,993	1.10	186	101	17,068	101	17,068	100.00	186	4.36
Genoa	329,221	1.50	494	174	57,284	174	57,284	100.00	494	3.45
Rock Island District	43,539	2.55	111	352	15,326	238	10,362	67.61	75	2.90
Total	1,730,042		1,559	711	138,876		133,912		1,523	4.55
From Minnesota River										
Genoa	14,757	1.90	28	180	2,656	180	2,656	100.00	28	4.22
Rock Island District	15,896	1.54	24	358	5,691	244	3,879	68.16	16	1.72
Total	30,653		52	538	8,347		6,535		44	2.69
From St. Paul										
Minnesota River	79,013	0.20	16	19	1,501	19	1,501	100.00	16	4.21
St. Croix River	136,578	1.03	141	49	6,692	49	6,692	100.00	141	8.41
Alma	4,940	1.10	5	88	435	88	435	100.00	5	5.00
Genoa	42,940	1.74	75	161	6,913	161	6,913	100.00	75	4.32
Rock Island District	278,953	2.38	664	339	94,565	225	62,764	66.37	441	2.81
East Gulf Coast	2,807	6.86	19	1,987	5,578	225	632	11.33	2	1.38
Total	545,231		920	2,643	115,684		78,937		680	3.44
From St. Croix River										
Rock Island District	2,338	2.50	6	330	772	216	505	65.41	4	3.03
From Winona										
Rock Island District	2,100	2.15	4	225	472	111	233	49.45	2	3.82
Total downbound shipments	2,310,364	-	2,541	4,447	264,151	-	220,122	-	2,253	4.09
Upbound shipments										
From St. Louis District										
Genoa	505,435	2.18	1,102	498	251,707	64	32,348	12.85	142	1.75
La Crosse	58,091	2.69	156	517	30,033	83	4,822	16.06	25	2.08
Winona	2,548	2.48	6	545	1,389	111	283	20.37	1	1.82
Alma	141,119	5.25	741	571	80,579	137	19,333	23.99	178	3.68
Red Wing	31,550	2.49	79	609	19,214	175	5,521	28.73	23	1.64
St. Croix River	643,358	2.49	1,602	650	418,183	216	138,965	33.23	532	1.53
St. Paul	372,121	2.99	1,113	659	245,228	225	83,727	34.14	380	1.81
Minnesota River	82,042	3.01	247	678	55,624	244	20,018	35.99	89	1.83
Total	1,836,264		5,046	4,727	1,101,957		305,017		1,370	1.80
From Illinois River										
Winona	1,300	2.48	3	506	658	111	144	21.88	1	1.96
St. Croix River	21,155	0.77	16	611	12,926	216	4,569	35.35	6	0.50
Total	22,455		19	1,117	13,584		4,713		7	0.59
From Lower Ohio River										
Genoa	264,085	1.49	393	1,026	270,951	64	16,901	6.24	25	0.58
La Crosse	3,117	2.69	8	1,045	3,257	83	259	7.95	1	1.03
Winona	24,563	2.55	63	1,073	26,356	111	2,726	10.34	7	0.95
Alma	95,327	5.59	533	1,099	104,764	137	13,060	12.47	66	2.04
St. Croix River	86,985	2.77	241	1,178	102,468	216	18,789	18.34	44	0.94
St. Paul	53,253	3.92	209	1,187	63,211	225	11,982	18.96	40	1.32
Minneapolis	52,323	3.76	197	1,204	62,997	242	12,662	20.10	40	1.25
Total	579,653		1,644	7,812	634,004		76,379		223	1.17
From Upper Ohio River										
La Crosse	13,644	1.60	22	1,679	22,908	83	1,132	4.94	1	0.38
Winona	28,172	2.48	70	1,707	48,090	111	3,127	6.50	5	0.58
Red Wing	1,419	3.10	4	1,771	2,513	175	248	9.87	-	0.70
St. Paul	9,541	3.76	36	1,821	17,374	225	2,147	12.36	4	0.83
Total	52,776		132	6,978	90,885		6,654		10	0.60
From West Gulf Coast										
Minneapolis	14,172	6.86	97	1,904	26,983	242	3,430	12.71	12	1.44
Total upbound shipments	2,505,320	-	6,938	22,538	1,867,413	-	396,193	-	1,622	1.64
Total downbound shipments	2,310,364		2,541	4,447	264,151		220,122		2,253	4.09
Total movement	4,815,684		9,479	26,985	2,131,564		616,315		3,875	2.51

(1) Based on 400 ton-miles per gallon.

Table E-19 - Savings on shipments to and from St. Paul District terminals in 1976 - petroleum products

Destination	Quantity (tons)	Savings per ton (\$)	Total savings \$1,000	System movement		St. Paul District movement		St. Paul District portion of total ton-miles (percent)	St. Paul District portion of savings (\$1,000)	Savings per gallon of fuel (\$)
				Miles	ton-miles	Miles	ton-miles			
<b>Downbound</b>										
<b>From St. Paul</b>										
Rock Island District	6,804	1.61	11	339	2,307	225	1,531	66.36	7	1.90
Lower Mississippi River	19,643	10.05	197	1,708	33,550	225	4,420	13.17	26	2.35
Upper Ohio River	36,704	3.76	138	1,821	66,838	225	8,258	12.36	17	0.83
Total	63,151		346	3,868	102,695		14,209		50	1.41
<b>From Pool 2</b>										
Minneapolis	62,864	2.02	127	22	1,383	22	1,383	100	127	36.73
St. Paul	846,984	0.02	17	9	7,623	9	7,623	100	17	0.89
Minnesota River	16,400	0.17	3	28	459	28	459	100	3	2.43
La Crosse	41,939	4.58	192	133	5,578	133	5,578	100	192	13.77
Genoa	12,263	4.86	60	152	1,864	152	1,864	100	60	12.79
Rock Island District	170,412	1.61	274	330	36,236	216	36,809	65.45	179	1.95
St. Louis District	51,748	8.88	460	650	33,636	216	11,178	33.23	153	5.46
Illinois Waterway	49,000	6.90	338	611	29,939	216	10,584	35.35	119	4.52
Upper Ohio River	5,518	3.76	21	1,812	9,999	216	1,192	11.92	3	0.83
Total	1,257,128		1,492	3,747	146,717		76,670		853	4.45
<b>From Pool 3 (Hastings)</b>										
La Crosse	10,521	4.06	43	89	936	89	936	100	43	18.25
Rock Island District	10,313	1.57	16	314	3,238	200	2,063	63.71	10	2.00
Total	20,834		59	403	4,174		2,999		53	7.07
<b>From La Crosse</b>										
Rock Island District	2,314	1.50	3	197	456	83	192	42.10	1	3.04
Total downbound	1,343,427		1,900	8,215	254,042		94,070		957	4.07
<b>Upbound</b>										
<b>From Winona</b>										
St. Paul	2,050	4.10	8	114	234	114	234	100	8	14.39
<b>From St. Louis District</b>										
Minneapolis	15,924	9.03	144	673	10,761	238	3,790	35.43	51	5.38
St. Paul	47,324	8.93	424	889	31,187	223	10,648	34.14	143	5.43
Minnesota River	25,063	9.04	227	678	18,993	244	6,113	35.90	82	5.33
Winona	71,846	9.40	875	545	39,156	111	7,975	20.37	137	6.90
La Crosse	23,717	8.13	193	517	12,262	83	1,369	16.05	31	6.29
Total	183,874		1,663	3,071	110,299		30,497		446	5.85
<b>From Illinois Waterway</b>										
Minneapolis	2,138	7.14	15	633	1,353	238	509	37.62	6	4.51
St. Paul	13,623	7.04	89	820	7,088	225	2,861	36.28	32	4.54
Minnesota River	4,387	7.14	31	639	8,797	244	1,888	38.21	12	4.47
La Crosse	26,662	5.91	217	478	17,524	83	3,043	17.36	38	4.94
Total	55,792		352	2,370	29,868		7,459		88	4.72
<b>From Lower Mississippi River</b>										
Pool 2	494,882	8.49	4,202	1,499	840,895	216	106,895	12.71	534	2.00
La Crosse	8,942	8.88	26	1,344	10,821	83	575	5.30	3	2.04
Total	501,824		4,228	3,263	851,676		107,471		537	2.00
<b>From Upper Ohio River</b>										
St. Paul	38,888	9.27	307	1,187	33,888	225	6,412	18.93	39	2.43
<b>From East Gulf Coast</b>										
Minneapolis	9,113	7.45	68	2,000	18,230	238	2,169	11.90	8	1.49
St. Paul	178,743	7.39	1,321	1,987	355,166	225	40,218	11.32	150	1.49
Newport	4,508	7.39	33	1,278	8,901	216	972	10.92	4	1.49
Total	192,360		1,422	5,965	382,297		43,359		162	1.49
<b>From West Gulf Coast</b>										
St. Paul	48,871	8.98	377	1,887	77,134	225	9,196	11.92	33	1.44
Total upbound	1,885,871		8,187	17,839	1,484,936		204,628		1,313	2.57
Total downbound	1,343,427		1,900	8,215	254,042		94,070		957	4.07
Total movement	2,368,698		10,087	26,074	1,738,998		298,698		2,270	3.04

Table E-20 - Savings on shipments to and from St. Paul District terminals in 1976 -  
chemicals and chemical products

Chemicals and chemical products						St. Paul District		St. Paul District	St. Paul District	Savings per
Destination	Quantity (tons)	Savings per ton (\$)	Total savings \$1,000	System movement		movement		portion of total ton-miles (percent)	portion of savings (\$1,000)	gallon of fuel (\$)
				Miles	1,000 ton-miles	Miles	1,000 ton-miles			
<u>Downbound</u>										
<u>From Minneapolis</u>										
Upper Ohio River	17,642	6.70	118	1,200	21,170	238	4,199	19.83	23	2.23
<u>Upbound</u>										
<u>From Rock Island District</u>										
St. Paul	1,520	6.50	10	339	515	225	342	66.37	6	7.67
Hastings	141,090	6.21	876	314	44,302	200	28,218	63.69	558	7.91
Winona	8,309	5.75	48	225	1,870	111	922	49.33	26	10.22
Total	150,919		934	878	46,687		29,482		590	8.00
<u>From St. Louis District</u>										
St. Paul	2,230	7.50	17	659	1,470	225	502	34.14	6	4.55
Minnesota River	5,558	7.50	42	678	3,768	244	1,356	35.99	15	4.42
Hastings	2,673	8.21	22	634	1,695	200	535	31.55	7	5.18
Winona	10,696	8.71	93	545	5,829	111	1,187	20.37	19	6.39
Total	21,157		174	2,516	12,762		3,580		47	5.25
<u>From Missouri River</u>										
Minnesota River	3,027	7.00	23	778	2,355	244	739	31.36	7	3.86
<u>From Illinois Waterway</u>										
St. Paul	1,357	6.20	8	620	841	225	305	36.29	3	4.00
Winona	1,512	5.70	9	506	765	111	168	21.94	2	4.51
Total	2,869		17	1,126	1,606		473		5	4.2
<u>From Middle Mississippi River</u>										
Minneapolis	4,172	9.32	39	1,083	4,518	238	993	21.98	9	3.44
St. Paul	10,037	9.28	93	1,070	10,740	225	2,258	21.03	20	3.47
Minnesota River	1,495	9.32	14	1,089	1,628	244	365	22.41	3	3.42
Hastings	31,629	9.18	290	1,045	33,052	200	6,326	19.14	56	3.51
Winona	5,605	9.05	51	956	5,358	111	622	11.61	6	3.79
Total	52,938		487	5,243	55,296		10,564		94	3.56
<u>From Lower Mississippi River</u>										
Minneapolis	11,281	9.68	109	1,721	19,415	238	2,685	13.83	15	2.25
St. Paul	88,596	10.14	898	1,708	151,322	225	19,934	13.17	118	2.37
Minnesota River	112,685	10.07	1,135	1,727	194,607	244	27,495	14.13	160	2.33
Hastings	306,114	10.03	3,070	1,683	515,190	200	61,223	11.88	365	2.38
Red Wing	1,485	10.15	15	1,658	2,462	175	260	10.55	2	2.45
Winona	71,198	10.09	718	1,594	113,490	111	7,903	6.96	50	2.53
Prairie du Chien	4,570	9.86	45	1,503	6,869	20	91	1.33	1	2.62
Total	595,929		5,990	11,594	1,003,355		119,591		711	2.39
<u>From Upper Ohio River</u>										
St. Paul	3,775	6.70	25	1,821	6,874	225	849	12.36	3	1.47
Winona	12,537	6.75	71	1,707	17,987	111	1,170	6.50	5	1.58
Total	14,312		96	3,528	24,861		2,019		8	1.54
<u>From East Gulf Coast</u>										
St. Paul	4,200	9.00	38	1,987	8,345	225	945	11.32	4	1.81
<u>From West Gulf Coast</u>										
Minneapolis	1,650	9.19	15	1,900	3,135	238	393	12.53	2	1.94
St. Paul	29,217	9.14	267	1,887	55,132	225	6,574	11.92	32	1.94
Minnesota River	22,666	9.20	209	1,906	43,201	244	5,531	12.80	27	1.93
Total	53,533		491	5,693	101,468		12,498		61	1.93
Total upbound	898,884		8,250	33,343	1,256,735		179,891		1,527	3.40
Total downbound	17,642		118	1,200	21,170		4,199		23	2.23
Total movement	916,526		8,368	34,543	1,277,905		184,090		1,550	3.37

Table E-21 - Savings on shipments to and from St. Paul District terminals in 1976 - iron scrap and iron and steel products.

Destination	Quantity (tons)	Savings per ton (\$)	Total savings \$1,000	System movement		St. Paul District movement	St. Paul District portion of total ton-miles (percent)	St. Paul District ton-miles of savings (\$1,000)	Savings per ton (\$)
				Miles	ton-miles	Miles			
<b>Downbound</b>									
<b>From Minneapolis</b>									
St. Louis District	4,996	27.00	135	632	3,357	238	35.42	48	16.02
Illinois Waterway	4,835	23.20	112	633	3,061	238	37.80	42	14.86
East Gulf Coast	1,353	33.00	45	2,000	2,708	238	11.90	5	6.80
Total	11,184		292	3,305	9,124	2,662		9	14.27
<b>From St. Paul</b>									
Illinois Waterway	3,445	23.20	80	620	2,136	225	36.29	24	14.97
Lower Mississippi River	4,000	34.40	21	1,708	1,025	225	13.17	3	8.05
Upper Ohio River	2,498	28.00	70	1,821	4,549	225	12.36	9	6.15
West Gulf Coast	1,200	33.00	40	1,887	2,264	225	11.92	5	6.99
Total	7,743		211	6,036	9,974	1,742		46	10.36
Total downbound	18,927		503	9,341	19,098	4,404		141	12.81
<b>Upbound</b>									
<b>From La Crosse</b>									
St. Paul	4,582	4.58	21	142	651	142	100	21	12.90
<b>From St. Louis District</b>									
St. Paul	8,527	27.00	230	659	5,619	225	34.13	78	16.46
<b>From Illinois Waterway</b>									
Minneapolis	33,988	23.20	789	633	21,514	238	37.80	46	14.86
St. Paul	24,345	23.20	565	620	15,094	225	36.29	205	14.97
Minnesota River	1,611	23.20	37	639	1,029	244	38.18	14	14.86
Red Wing	38,322	15.20	582	570	21,844	175	30.70	174	10.61
Total	98,266		1,973	2,462	59,481	20,666		694	13.43
<b>From Lower Mississippi River</b>									
Minneapolis	16,328	34.40	562	1,721	28,100	238	13.83	78	8.05
St. Paul	3,561	34.40	122	1,708	6,082	225	13.17	16	8.05
Minnesota River	840	34.40	29	1,727	1,451	244	14.13	2	7.99
Total	20,729		713	5,156	35,633	4,892		98	8.01
<b>From Lower Ohio River</b>									
Minneapolis	2,826	36.00	102	1,200	3,391	238	34.83	20	12.00
<b>From Upper Ohio River</b>									
Minneapolis	11,711	32.00	375	1,834	21,478	238	12.96	44	6.98
St. Paul	15,986	32.00	512	1,821	29,111	225	12.36	63	7.01
Minnesota River	18,684	32.00	598	1,440	34,379	244	13.26	76	6.98
Red Wing	11,951	30.40	363	1,771	21,165	175	9.86	9	6.62
Winona	1,564	28.60	45	1,707	2,670	111	6.50	3	6.20
La Crosse	681	27.50	19	1,679	1,143	83	4.94	1	6.00
Total	60,577		1,912	10,652	109,946	1,126		211	6.96
Total upbound	195,507		4,951	20,271	214,721	42,066		1,142	10.46
Total downbound	18,927		503	9,341	19,098	4,404		141	12.81
Total movement	214,434		5,454	29,612	233,819	46,470		1,283	11.04

Table E-22 - Savings on shipments to and from St. Paul District terminals in 1976 - farm products

Location	Quantity (tons)	Savings per ton (\$)	Total savings \$1,000	System movement		St. Paul District movement		St. Paul District portion of total ton-miles (percent)	St. Paul District portion of savings (\$1,000)	Savings per gallon of fuel (\$)
				Miles	ton-miles	Miles	ton-miles			
<u>Downbound</u>										
<u>From Minneapolis</u>										
Winona	4,051	4.32	18	127	514	127	514	100	17	1.61
St. Louis District	57,796	6.33	366	672	38,839	238	13,755	35.42	130	3.77
Lower Mississippi River	298,637	7.26	2,168	1,721	513,954	238	71,076	13.83	300	2.69
Lower Ohio River	6,926	6.40	44	1,200	8,311	238	1,648	19.83	9	2.13
Upper Ohio River	28,485	6.40	182	1,834	52,241	238	6,779	12.98	24	1.40
East Gulf Coast	15,328	8.80	135	2,000	30,656	238	3,648	11.90	16	1.76
Total	411,223		2,913	7,554	644,515		97,420		496	2.04
<u>From St. Paul</u>										
Winona	9,438	4.20	40	114	1,076	114	1,076	100	40	1.74
St. Louis District	76,827	6.33	486	659	50,629	225	17,286	34.14	166	3.84
Middle Mississippi River	1,506	6.90	10	1,070	1,611	225	339	21.03	2	2.58
Lower Mississippi River	1,645,127	7.26	11,944	1,708	2,809,877	225	370,154	13.17	1,573	1.70
Lower Ohio River	38,338	6.40	245	1,187	45,507	225	8,626	18.96	47	2.16
Upper Ohio River	156,370	6.40	1,001	1,821	284,750	225	35,183	12.36	124	1.41
East Gulf Coast	58,482	8.80	515	1,987	116,204	225	13,158	11.32	58	1.77
Total	1,986,088		14,241	8,546	3,309,654		445,822		2,010	1.80
<u>From Minnesota River</u>										
Winona	10,214	3.40	35	133	1,358	133	1,358	100	35	10.23
La Crosse	1,381	3.70	5	161	222	161	222	100	5	9.19
Rock Island District	2,740	5.32	15	358	981	244	669	68.16	10	5.94
St. Louis District	98,592	6.33	624	678	66,845	244	24,056	35.99	225	3.73
Middle Mississippi River	24,789	9.00	223	1,089	26,995	244	6,049	22.41	50	3.31
Lower Mississippi River	2,148,231	7.26	15,596	1,727	3,709,995	244	524,168	14.13	2,204	1.68
Lower Ohio River	22,598	6.40	145	1,206	27,253	244	5,514	20.23	29	2.12
Upper Ohio River	171,975	6.40	1,101	1,840	316,434	244	41,962	13.26	146	1.39
East Gulf Coast	76,534	8.80	673	2,006	153,527	244	18,674	12.16	82	1.75
West Gulf Coast	1,387	8.80	12	1,906	2,644	244	338	12.80	2	1.85
Total	2,558,441		18,429	11,104	4,306,254		623,010		2,788	1.79
<u>From Red Wing</u>										
Winona	5,572	2.69	15	64	357	64	357	100	15	16.81
St. Louis District	3,041	6.33	19	609	1,852	175	532	28.74	6	4.16
Lower Mississippi River	318,936	8.80	2,807	1,658	528,796	175	55,814	10.55	296	2.12
Upper Ohio River	7,947	6.40	51	1,771	14,074	175	1,391	9.88	5	1.45
East Gulf Coast	1,331	8.80	12	1,937	2,578	175	233	9.03	1	1.82
Total	336,827		2,904	6,039	547,657		58,327		323	2.22
<u>From Winona</u>										
Lower Mississippi River	434,708	8.80	3,825	1,594	692,925	111	48,253	6.96	266	2.21
Upper Ohio River	1,646	6.40	11	1,707	2,826	111	183	6.50	1	1.50
East Gulf Coast	2,901	8.80	26	1,873	5,434	111	322	5.93	2	1.88
Total	439,255		3,862	5,174	701,185		48,758		269	2.21
<u>From La Crosse</u>										
Middle Mississippi River	1,333	6.20	8	928	1,237	83	111	8.94	1	2.67
Lower Mississippi River	124,426	8.80	1,095	1,566	194,851	83	10,327	5.30	58	2.25
Upper Ohio River	4,011	6.40	26	1,045	4,191	83	333	7.94	2	2.45
East Gulf Coast	4,502	8.80	40	1,845	8,306	83	374	4.50	2	1.91
Total	134,272		1,169	5,384	208,585		11,145		63	2.26
<u>From McGregor-Prairie du Chien</u>										
St. Louis District	1,180	5.90	7	454	536	20	24	4.40	0	5.19
Lower Mississippi River	613,120	7.00	4,292	1,503	921,519	20	12,262	1.33	57	1.86
Lower Ohio River	1,390	6.40	9	982	1,365	20	28	2.04	0	2.61
East Gulf Coast	13,131	8.80	116	1,782	23,399	20	263	1.12	1	1.97
Total	628,821		4,424	4,721	946,819		12,577		58	1.87
Total downbound	6,494,927		47,942	48,522	10,664,669		1,297,059		6,007	1.85
<u>Upbound</u>										
<u>From Rock Island District</u>										
St. Paul	1,633	6.33	10	339	554	225	367	66.37	7	7.47
Total movement	6,496,560		47,952	48,861	10,665,223		1,297,426		6,014	1.85

Table E-23 - Savings on shipments to and from St. Paul District terminals in 1976 - nonmetallic minerals (cement, sand, etc.)

	Quantity (tons)	Savings per ton (\$)	Total savings \$1,000	System movement 1,000		St. Paul District movement 1,000		St. Paul District portion of total con-miles (percent)	St. Paul District portion of savings (\$1,000)	Savings per gallon of fuel (\$)
				Miles	con-miles	Miles	con-miles			
<b>Downbound</b>										
<b>From Minneapolis</b>										
St. Louis District	1,575	10.44	16	72	1,058	238	375	35.42	6	6.21
Lower Mississippi River	166,267	14.10	2,344	21	286,146	238	39,572	13.83	324	3.28
Upper Ohio River	10,058	10.39	105	834	18,446	238	2,394	12.98	14	2.27
East Gulf Coast	22,057	13.79	304	1,000	44,114	238	5,250	11.90	36	2.76
West Gulf Coast	1,250	13.79	17	1,900	2,375	238	298	12.53	2	2.90
<b>Total</b>	<b>201,207</b>		<b>2,786</b>	<b>8,127</b>	<b>352,139</b>		<b>47,889</b>		<b>382</b>	<b>3.19</b>
<b>From St. Paul</b>										
St. Louis District	9,119	10.21	93	659	6,009	225	2,052	34.14	32	6.20
Lower Mississippi River	146,884	13.42	1,941	1,708	250,878	225	33,049	13.17	260	3.14
Upper Ohio River	3,075	10.40	32	1,821	5,600	225	692	12.36	4	2.29
<b>Total</b>	<b>159,078</b>		<b>2,096</b>	<b>4,188</b>	<b>262,487</b>		<b>35,793</b>		<b>296</b>	<b>3.31</b>
<b>From Minnesota River</b>										
Middle Mississippi River	1,396	12.69	18	1,089	1,520	244	341	22.41	6	4.66
Lower Mississippi River	65,116	13.57	886	1,727	112,455	244	15,888	14.13	125	3.14
Lower Ohio	2,620	10.86	28	1,206	3,160	244	639	20.23	6	3.60
Upper Ohio River	20,437	10.45	214	1,840	37,604	244	4,987	13.26	28	2.27
<b>Total</b>	<b>89,569</b>		<b>1,144</b>	<b>5,862</b>	<b>154,739</b>		<b>21,855</b>		<b>163</b>	<b>2.98</b>
<b>From Hastings</b>										
Lower Mississippi River	129	13.69	2	1,683	217	200	26	11.98	0	3.28
<b>From Red Wing</b>										
St. Louis District	2,664	9.69	26	609	1,622	175	466	28.74	7	6.37
Lower Mississippi River	56,256	12.91	726	1,658	93,272	175	9,845	10.55	77	3.11
Lower Ohio River	2,759	10.70	29	1,137	3,137	175	481	15.49	5	3.76
Upper Ohio River	2,764	9.92	27	1,271	4,895	175	484	9.88	3	2.24
<b>Total</b>	<b>64,443</b>		<b>808</b>	<b>5,175</b>	<b>102,926</b>		<b>11,278</b>		<b>92</b>	<b>3.26</b>
<b>From Winona</b>										
Lower Mississippi River	2,480	12.62	31	1,594	3,953	111	275	6.96	2	3.17
<b>From La Crosse</b>										
Middle Mississippi River	3,154	12.70	40	928	2,932	83	262	8.94	3	4.61
Lower Mississippi River	218	12.12	3	1,566	341	83	18	5.30	0	3.20
<b>Total</b>	<b>3,372</b>		<b>43</b>	<b>2,494</b>	<b>3,273</b>		<b>280</b>		<b>3</b>	<b>4.52</b>
<b>Total downbound</b>	<b>520,283</b>		<b>6,905</b>	<b>29,123</b>	<b>879,734</b>		<b>117,396</b>		<b>936</b>	<b>3.19</b>
<b>Upbound</b>										
<b>From Pool 2</b>										
Minneapolis	335,346	11.16	3,746	22	7,378	22	7,378	100.	3,746	59.27
St. Paul	1,241,327	11.74	14,573	9	11,174	9	11,174	100.	14,573	112.89
<b>Total</b>	<b>1,576,673</b>		<b>18,319</b>	<b>31</b>	<b>18,552</b>		<b>18,552</b>		<b>18,319</b>	<b>91.54</b>
<b>From Rock Island District</b>										
St. Paul	24,459	8.33	204	339	8,292	225	5,503	66.17	135	9.83
Pool 2	24,102	8.02	193	330	1,420	216	929	65.45	122	9.72
<b>Total</b>	<b>48,561</b>		<b>397</b>	<b>669</b>	<b>9,712</b>		<b>6,432</b>		<b>257</b>	<b>9.80</b>
<b>From St. Louis District</b>										
Minneapolis	28,082	10.44	293	672	86,071	238	30,484	35.42	104	6.21
St. Paul	1,541	10.21	16	659	1,016	225	347	34.14	5	6.20
Red Wing	1,765	9.69	17	609	1,075	175	309	28.74	5	6.36
Winona	10,225	8.92	91	545	5,573	111	1,135	20.17	19	6.55
La Crosse	27,922	8.71	243	517	18,792	83	6,228	18.07	55	6.74
<b>Total</b>	<b>69,535</b>		<b>659</b>	<b>3,002</b>	<b>132,527</b>		<b>38,501</b>		<b>608</b>	<b>6.38</b>
<b>From Illinois - Quincy</b>										
St. Paul	1,353	6.20	84	620	4,559	225	1,654	36.29	17	4.30
Quincy	4,337	5.92	257	570	762	175	234	30.70	2	4.15
Winona	1,362	5.70	78	506	689	111	131	21.94	2	4.51
La Crosse	1,546	5.66	88	478	739	83	128	17.36	2	4.73
<b>Total</b>	<b>11,598</b>		<b>499</b>	<b>2,174</b>	<b>6,749</b>		<b>2,167</b>		<b>23</b>	<b>4.21</b>
<b>From Mississippi River</b>										
Minneapolis	1,989	14.13	28	1,721	3,423	238	473	11.81	4	3.28
St. Paul	58,864	14.02	825	1,708	100,540	225	13,244	13.17	109	3.18
Minnesota River	28,240	14.17	400	1,727	48,770	244	6,891	14.13	54	3.28
Winona	23,386	14.10	330	1,594	37,277	111	2,586	6.96	21	1.54
La Crosse	57,394	13.15	757	1,566	90,192	83	4,780	5.30	10	1.36
<b>Total</b>	<b>170,073</b>		<b>2,340</b>	<b>8,316</b>	<b>280,202</b>		<b>27,984</b>		<b>195</b>	<b>3.36</b>
<b>From Gulf Coast</b>										
Minneapolis	1,487	13.76	20	2,000	2,974	238	354	11.90	2	2.75
St. Paul	81,223	13.72	1,114	1,987	161,390	225	18,275	11.32	26	2.76
East Gulf Coast	206,052	13.80	2,844	2,006	413,340	244	50,777	12.16	366	2.75
West Gulf Coast	8,821	13.74	121	1,937	17,086	175	1,544	9.03	11	2.84
Winona	2,721	13.22	36	1,873	5,096	111	302	5.93	2	2.82
La Crosse	20,950	12.84	269	1,845	38,653	83	1,739	4.50	12	2.78
<b>Total</b>	<b>40,098</b>	<b>12.48</b>	<b>500</b>	<b>1,782</b>	<b>71,455</b>	<b>20</b>	<b>702</b>	<b>1.12</b>	<b>6</b>	<b>2.80</b>
<b>Total upbound</b>	<b>361,352</b>		<b>4,904</b>	<b>13,430</b>	<b>709,994</b>		<b>73,293</b>		<b>505</b>	<b>2.76</b>
<b>From Gulf Coast - East</b>										
St. Paul	7,482	13.79	103	1,900	14,216	238	1,781	11.53	13	2.90
<b>Total</b>	<b>2,372,783</b>		<b>14,018</b>	<b>29,522</b>	<b>1,171,952</b>		<b>168,712</b>		<b>5,787</b>	<b>3.71</b>
<b>Total downbound</b>	<b>520,283</b>		<b>6,905</b>	<b>29,123</b>	<b>879,734</b>		<b>117,396</b>		<b>936</b>	<b>3.19</b>
<b>Total movement</b>	<b>2,893,066</b>		<b>20,923</b>	<b>58,645</b>	<b>2,051,686</b>		<b>286,108</b>		<b>6,723</b>	<b>3.40</b>

Table E-24 - Summary of savings on shipments to and from St. Paul District terminals in 1976 at 1978 price levels

Commodity		Total system		St. Paul District		Percent of total savings
		Quantity (1,000 tons)	Movement (1,000 ton-miles)	Savings (\$1,000)	Movement (1,000 ton miles)	Savings (\$1,000)
Coal	Downbound	2,310	264,151	2,541	220,122	2,253
	Upbound	2,505	1,867,413	6,938	396,193	1,622
	Total	4,815	2,131,564	9,479	616,315	3,875
Petroleum products	Downbound	1,343	254,042	1,900	94,070	957
	Upbound	1,005	1,484,956	8,187	204,628	1,313
	Total	2,348	1,738,998	10,087	298,698	2,270
Chemicals and chemical products	Downbound	18	21,170	118	4,199	23
	Upbound	899	1,256,735	8,250	179,891	1,527
	Total	917	1,277,905	8,368	184,090	1,550
Iron scrap and steel products	Downbound	19	19,098	503	4,404	141
	Upbound	196	214,721	4,951	42,066	1,142
	Total	215	233,819	5,454	46,470	1,283
Farm products (grain, etc.)	Downbound	6,495	10,664,669	47,942	1,297,059	6,007
	Upbound	2	554	10	367	7
	Total	6,497	10,665,623	47,952	1,297,426	6,014
Nonmetallic minerals, cement, sand, etc.	Downbound	520	879,734	6,905	117,396	938
	Upbound	2,373	1,171,952	14,018	168,712	5,787
	Total	2,893	2,051,686	20,923	286,108	6,725
Total shipments to and from St. Paul District terminals	Downbound	10,705	12,102,864	59,909	1,737,250	10,319
	Upbound	6,980	5,996,331	42,354	991,857	11,398
	Total	17,685	18,099,195	102,263	2,729,107	21,717



Table E-25 - Conversion of basic data to 1979 estimated shipments and price levels

Item	Unit	1976 shipments and 1978 price levels	1979 shipments and price levels
Total shipments to and from St. Paul District terminals	1,000 tons	17,684	19,450
Total waterway system:			
Savings	1,000 dollars	102,263	121,583
Average savings per ton	Dollars	5.78	6.25
Ratio of 1979 savings to 1976-1978 savings	Percent	-	118.9
St. Paul District:			
Savings	1,000 dollars	21,717	25,830
Average savings per ton	Dollars	1.227	1.327
Ratio of 1979 savings to 1976-1978 savings	Percent	-	118.9
Ratio of St. Paul District to system			
Savings	Percent	21.23	21.23

### Savings on Future Traffic

The basis for the determination of the probable future growth in shipments to and from St. Paul District terminals has been presented earlier and is illustrated on figure E-6 as curve 8. Total shipments are projected to increase from about 19,450,000 tons in 1979 to 33,400,000 tons by year 2029. Table E-26 illustrates the steps followed in translating projected increases in commodity shipments to future savings and to the present worth (1979) of the future savings. The average annual future savings are currently estimated at \$5,335,000, recognizing the limiting effect of congestion at lock and dam 26.

Table E-26 - Determination of average annual future transportation benefits, restricted growth<sup>(1)</sup> (St. Paul District)

Year	Number of years	Increase in shipments (in 1,000 tons)	Average savings per ton (in \$1.00)	Future annual savings (in \$1,000)	Present worth of \$1.00	Present worth of future savings (in \$1,000)
1979	0	0	1.327			
	2	750		995	0.8714	867
	4	1,250		1,659	0.7593	1,260
	6	1,650		2,190	0.6617	1,449
	8	2,050		2,720	0.5766	1,568
1989	10	2,350		3,118	0.5024	1,566
	12	3,450		4,578	0.4378	2,004
	14	4,350		5,772	0.3815	2,202
	16	5,150		6,834	0.3325	2,272
	18	5,750		7,630	0.2897	2,210
1999	20	6,450		8,559	0.2524	2,160
	22	7,000		9,289	0.2200	2,044
	24	7,550		10,019	0.1917	1,921
	26	8,150		10,815	0.1670	1,806
	28	8,650		11,478	0.1456	1,671
2009	30	9,150		12,142	0.1268	1,540
	32	9,750		12,938	0.1105	1,430
	34	10,250		13,602	0.0963	1,310
	36	10,750		14,265	0.0839	1,197
	38	11,250		14,928	0.0731	1,091
2019	40	11,650		15,459	0.0637	985
	42	12,150		16,123	0.0555	895
	44	12,650		16,786	0.0484	812
	46	13,050		17,317	0.0422	731
	48	13,450		17,848	0.0367	655
2029	50	13,950		18,512	0.0320	592
Total (25 yrs)		192,600		255,576		36,238
Total (50 yrs)		385,200		511,152		72,478

Average annual future savings at 7 1/8 percent interest rate amortized over 50 years (\$72,478,000 x 0.07361 = \$5,335,000).

(1) Before user tax.

### Impact of Authorized User Taxes

The Inland Waterways Revenue Act of 1978 provided for a tax on fuel used in commercial transportation on the inland waterway system. The tax was set at 4 cents a gallon after 30 September 1980 until 1 October 1981, 6 cents a gallon for the next 2 years, 8 cents a gallon for the following 2 years, and 10 cents a gallon after 30 September 1985. The Act also provides for a trust fund, consisting of the funds collected through the fuel tax, to be made available for construction and rehabilitation projects on the inland waterways system as provided by authorization and appropriation acts. The legislation provides for findings and recommendations which could result in changes in user charges. However, at this point, only the effects of the currently scheduled fuel tax are evaluated and only on the commodities shipped to and from terminals in the St. Paul District.

A determination of the effect of the fuel tax requires several assumptions as follows:

1. The fuel tax will increase water transportation rates and result in a corresponding reduction in savings creditable to the waterway system.
2. The mix of commodities moved will not change significantly.
3. Although quantities moved will increase, the origins and destinations will remain substantially unchanged so that the total number of ton-miles will be changed from the 1976 data only through increases in tonnage.
4. Fuel consumption will average about 400 ton-miles per gallon.  
(A number of studies have been made in recent years of fuel consumption per ton-mile on the inland waterways including that by Marvin Barloon,<sup>(1)</sup> giving an estimate of 333 ton-miles per gallon; another<sup>(2)</sup> based on a review of

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(1) Barloon, Marvin J., Case Western Reserve University, Cleveland, Ohio, "Shallow-Draft Inland Waterway Fuel Consumption and Cost Sharing," 6 November 1973.

(2) "The Economic Impact of Waterborne Transportation on the Upper Mississippi River Basin," Upper Mississippi Waterway Association, July 1975.

the records of 11 barge lines operating on the Mississippi River and tributaries producing an average fuel use of 419 ton-miles per gallon; and the results of a recent study by Samuel E. Eastman, Washington economic consultant and former director of the Policy Review Office of the Department of Transportation, giving a national average for fuel used in waterway traffic of 514 ton-miles per gallon.)

5. The St. Paul District portion of the savings will remain at 21.23 percent as determined in the detailed terminal-to-terminal analysis of 1976 District traffic.

Tables E-27, E-28, and E-29 show the procedure followed to determine the effect of the fuel tax on the transportation savings assigned to the St. Paul District.

Table E-27 - Effect of fuel tax on transportation savings creditable to St. Paul District with no future growth

Year	Number of years	Shipments <sup>(1)</sup> (1,000 tons)	Shipments <sup>(1)</sup> (1,000 ton miles)	Fuel used <sup>(2)</sup> (1,000 gallons)	Tax per gallon (\$)	Tax (\$1,000)	St. Paul District share of tax 21.23% (\$1,000)	St. Paul District savings (\$1,000)
1979	0	19,450	19,904,385	49,761	0	0	0	(25,810)
1980	1				0.0089	443	94	25,716
1981	2				0.04	1,990	422	25,388
1982	3				0.06	2,986	634	25,176
1983	4				0.06	2,986	634	25,176
1984	5				0.08	3,981	845	24,965
1985	6				0.08	3,981	845	24,965
1986	7				0.10	4,976	1,056	24,754
1987	8					4,976	1,056	24,754
1988	9					4,976	1,056	24,754
1989	10					4,976	1,056	24,754
1990-2029	40				0.10	199,044	42,257	990,143
Total (50 years)				2,488,048		235,315	49,955	1,240,545
Average annual						4,706	999	24,811

(1) Average annual shipments, from table E-25.

(2) Average annual fuel consumption at 400 ton-miles per gallon.

Table E-28 - Determination of fuel tax on estimated future growth of shipments to and from St. Paul District terminals

Year	Number of years	Increase		Average distance (1,000 miles)	Total (1,000 ton miles)	Fuel used per year (1,000 gallons)	Tax rate		Total tax (\$1,000)
		in shipments (1,000 tons)	in shipments (1,000 tons)				per gallon (\$)	per gallon (\$)	
1979	0	0	0	1,023 (1)	0	0	0	0	0 (2)
1981	2	750	750	1,023	767,250	1,918	0.04	0.04	43
1983	4	1,250	1,250	1,023	1,268,750	3,197	0.06	0.06	192
1985	6	1,650	1,650	1,023	1,687,950	4,220	0.08	0.08	338
1987	8	2,050	2,050	1,023	2,097,150	5,243	0.10	0.10	524
1989	10	2,350	2,350	1,023	2,404,050	6,010	0.10	0.10	601
1991	12	3,450	3,450	1,023	3,529,350	8,823	0.10	0.10	882
1993	14	4,350	4,350	1,023	4,450,050	11,125	0.10	0.10	1,112
1995	16	5,150	5,150	1,023	5,268,450	13,171	0.10	0.10	1,317
1997	18	5,750	5,750	1,023	5,882,250	14,706	0.10	0.10	1,471
1999	20	6,450	6,450	1,023	6,598,350	16,496	0.10	0.10	1,650
2001	22	7,000	7,000	1,023	7,161,000	17,902	0.10	0.10	1,790
2003	24	7,550	7,550	1,023	7,723,650	19,309	0.10	0.10	1,931
2005	26	8,150	8,150	1,023	8,337,450	20,844	0.10	0.10	2,084
2007	28	8,650	8,650	1,023	8,848,950	22,122	0.10	0.10	2,212
2009	30	9,150	9,150	1,023	9,360,450	23,401	0.10	0.10	2,340
2011	32	9,750	9,750	1,023	9,974,250	24,936	0.10	0.10	2,494
2013	34	10,250	10,250	1,023	10,485,750	26,214	0.10	0.10	2,621
2015	36	10,750	10,750	1,023	10,997,250	27,493	0.10	0.10	2,749
2017	38	11,250	11,250	1,023	11,508,750	28,772	0.10	0.10	2,877
2019	40	11,650	11,650	1,023	11,917,950	29,795	0.10	0.10	2,979
2021	42	12,150	12,150	1,023	12,429,450	31,073	0.10	0.10	3,107
2023	44	12,650	12,650	1,023	12,940,950	32,352	0.10	0.10	3,235
2025	46	13,050	13,050	1,023	13,350,150	33,375	0.10	0.10	3,338
2027	48	13,450	13,450	1,023	13,759,350	34,398	0.10	0.10	3,440
2029	50	13,950	13,950	1,023	14,270,850	35,677	0.10	0.10	3,568
Total (25 years)		192,600				492,572			48,895
Total (50 years)		385,200				985,144			97,790

(1) From table E-24 (18,097,129,000 ton-miles/17,684 tons = 1,023,362 miles).

(2) Tax applicable only after 30 September 1980, say 1 1/4 years. Thus, 1980 tax = 1/4 of \$0.04 x 959,000 gallons or \$10,000 + 1981 tax = \$0.04 x 1,918,000 or \$76,000 - so that 2-year average = \$86,000/2 or \$43,000.



The effect of the currently authorized fuel tax on transportation savings is summarized in table E-30. The analysis indicates that, with no allowance for future growth, the average annual tax on fuel used in moving commodities by water to and from St. Paul District terminals would amount to about \$4.7 million. Average annual transportation savings would be reduced from about \$121.6 million to \$116.9 million. Taking into account the present worth of the future growth in waterborne commerce, the average annual system savings would total about \$126.9 million. The tax would reduce this amount by about \$5.7 million annually, leaving a net savings of about \$121.2 million per year.

Based on the earlier determination that 21.23 percent of the transportation savings (benefits) are creditable to the St. Paul District portion of the waterway system, the overall savings including future growth in commodity movements would be about \$27.0 million. The net savings after subtracting the prorated share of the fuel tax would approximate \$25.8 million.

Table E-30 - Summary of average annual transportation savings (\$1,000)

Item	No future growth	Future growth <sup>(2)</sup>	Total
System:			
Savings	121,583 <sup>(2)</sup>	5,335	126,918
Tax	<u>4,706<sup>(3)</sup></u>	<u>987</u>	<u>5,693</u>
Net savings	116,877	4,348	121,225
St. Paul District:			
Savings	25,830 <sup>(2)</sup>	1,133	26,963
Tax	<u>999<sup>(3)</sup></u>	<u>210</u>	<u>1,209</u>
Net savings	24,831 <sup>(3)</sup>	923	25,754

(1) Totals shown are the present worth of each item from table E-29.

(2) See table E-25.

(3) See table E-27.

## SENSITIVITY ANALYSIS

The growth in commodity movements by water to and from terminals on the Upper Mississippi River could result in long delays at congestion points, particularly at lock and dam 26 where replacement of the existing lock is not expected to be completed until 1987 and the need for a second lock is still being considered. Other factors which bear on the rate of growth of waterborne traffic include the adequacy of supplies and future demand for the commodities shipped by water, variations between water and overland shipment costs, the magnitude of user charges, the desires of both commercial and recreation craft operators to minimize delays at the locks, the price of fuel, and the adequacy of fuel supplies. The sensitivity of the estimate of transportation savings to variations of these factors is discussed in the following paragraphs.

### Traffic Delays

The effects of delays in commodity movements caused by groundings, lock congestions, or other causes are increases in shipment costs resulting from inefficient use of equipment and manpower, inability to meet delivery dates, and price changes which may affect expected profits. However, only when the delays become excessive and shipment costs approach those of the least cost practical alternative are changes in transportation mode probable.

### Alternative Estimates of Future Growth Rates

In the foregoing analyses, consideration has been given to the probable future benefits based on a conservative estimate of unrestricted growth and an assumed restricted growth due primarily to traffic delays at lock and dam 26. The unrestricted growth assumes a gradual slowdown in growth with near zero growth after year 2029. Two additional growth rates were considered; one assuming uniform growth over the 50-year period attaining a maximum in 2029 of 45,000,000 tons and the other also with uniform growth



but reaching a maximum of only 28,000,000 tons by 2029. Also, in accordance with the Water Resources Council guidelines, two additional modifications of the unrestricted and restricted growth relations have been developed, each assuming no further growth after 20 years. The effects of these variations in the rate of growth of commercial traffic on the present worth of future transportation benefits are summarized in table E-31.

Table E-31 - Summary of alternative average annual transportation benefits at 1979 price levels <sup>(1)</sup>

Alternative	Assumed variations in the rate of future growth in commodity shipments	Present worth of future benefits <sup>(2)</sup>		1979 average annual benefits	Total average annual benefits
		(\$1,000)		(\$1,000)	(\$1,000)
		<u>System</u>		<u>St. Paul District</u>	
1	Straight-line growth to 45,000,000 tons by 2029	8,869	1,882	24,811	26,693
2	Unrestricted normal growth to 35,200,000 tons by 2029	8,034	1,706	24,811	26,517
3	Unrestricted growth for 20 years, no growth thereafter	7,162	1,520	24,811	26,331
4	Restricted growth due to bottleneck at L/D 26	4,348	923	24,811	25,734
5	Restricted growth for 20 years, no growth thereafter	4,356	925	24,811	25,736
6	Straight-line growth to 28,000,000 tons by 2029	2,968	630	24,811	25,441

(1) Includes reduction in savings resulting from fuel tax.

(2) Based on 50-year period from 1979 to 2029 and an interest rate of 7 1/8 percent.

On the basis of the several assumed variations in future waterborne traffic to and from St. Paul District terminals, the present worth of the St. Paul District share of future benefits could vary from about \$1.9 to \$0.6 million. Total benefits would vary from \$26.7 to \$25.4 million representing a difference of about \$1.3 million. Of the several alternative growth assumptions considered, the restricted growth reaching a maximum traffic of 33,400,000 tons at the end of the 50-year period falls near the midpoint of the projections and at this time is considered to best represent the future traffic. Thus, the average annual estimate of benefits totaling \$25,754,000 is reasonable.

### Lock Congestion

In situations 1A and 2 of the University of Minnesota traffic study, the authors estimated annual commodity movements at 33,467,000 to 45,182,000 tons, respectively, somewhat greater than the 30,274,000 tons considered most probable in this study. They found a maximum use at locks and dam 2 by commercial craft of 67 percent of the time in August and 50 percent or less at other locks. If shipments were distributed uniformly over the navigation season, lock usage would be less than 50 percent of the time. On this basis, the locks in the St. Paul District could handle the projected commerce without excessive congestion. However, when considered with the lockages required by recreation craft, usage at locks and dam 2 approaches 100 percent and usage at locks and dams 3 and 10 is almost as much. Thus, before the end of the 50-year period, further consideration will have to be given to separate locks for recreation craft at some of the structures. Several downstream locks in the system could have similar problems in handling combined recreation and commercial traffic. At the present, congestion occurs only on weekends and holidays and may best be handled by providing waiting areas for recreation craft and alternating commercial with recreation craft lockages.

### Fleeting Areas

St. Paul is the principal area in the St. Paul District where tows are assembled and disassembled and shuttled in groups of two or more barges to terminals in St. Paul and Minneapolis and on the Minnesota River. Fleeting areas now available are able to handle the existing traffic without causing delays, but the problem can be expected to increase in the future. Further designation of fleeting areas in and near St. Paul is opposed by individuals concerned with the impact on the environment and general aesthetics of the river corridor. Suitable fleeting areas are available downstream from St. Paul and will be used when needed. Some additional costs for shuttle service can be expected but they should not significantly affect commodity shipments to or from the area.

### Fuel Prices

During recent years, fuel prices (which constitute a major part of shipment costs) have increased at a rapid rate because the United States depends on foreign imports of petroleum products. In spite of the emphasis on energy conservation, new oil exploration and discovery, synthetic fuels, and alternative energy sources, our dependence on imports is expected to continue well into the future. As a result, the price of fuel can be expected to rise significantly, necessitating rate changes at regular intervals. Increasing fuel prices, which affect all modes of transportation, will increase emphasis on use of the most economical means of moving commodities. For bulk commodity shipments, the most economical method for long-haul and even some short-haul movements is by water when available. Increases in fuel costs tend to increase the savings obtained by using water transportation and expand the limits for rail or truck overland shipments to and from river terminals. Thus, with the continuing increases in fuel costs, a corresponding growth in use of water as a major mode of moving bulk commodities seems probable.

### Availability of Fuel Supplies

Barring an unforeseen breakthrough in energy production, the United States and other developed countries will continue to depend on petroleum and petroleum products to maintain their economic growth and high standards of living. The United States consumes about 18 million barrels per day of crude oil, or <sup>6,570</sup>~~6,750~~ million barrels per year. Many authorities doubt that existing proven supplies and future discoveries can meet the world's needs for the next 50 years. Shipments by water to and from St. Paul District terminals in 1979 consumed about 1.18 million barrels of fuel, which is only a small part of the total consumption. Nevertheless, the consumption of the entire transportation industry is a significant part of the total fuel consumption each year. Because petroleum is not a renewable resource, the limited petroleum supplies may have to be rationed. The private sector of the economy would be affected first but the commercial

transport industry would eventually be affected. A reduction in available fuel supplies would divert commodity movements to the least fuel-consumptive transportation mode and could result in an increase in shipments by water. A shortage of petroleum could produce an increased demand for coal, particularly the low sulfur western coal, and a corresponding increase in downbound coal shipments. Although projections of future river-borne commodity shipments are particularly sensitive to any limitations of petroleum supplies, no firm basis for predicting if a shortage will develop or what its effect might be is possible.

#### User Taxes

Many of the GREAT I recommendations would significantly increase the cost of maintaining the 9-foot channel. The extent to which such actions might be undertaken without exceeding the limits of economic feasibility could be affected by the user fuel tax. If the tax results in increased water shipment rates while rates by the least-cost alternative mode remained unchanged, the transportation savings (benefits) would be reduced and the benefit-cost ratio would move toward unity. Thus, the user tax could affect the decision to adopt measures which would increase project costs. At this time, many questions, including the following, remain unanswered:

1. What effect would the present user tax (scheduled to rise by 1985 to 10 cents per gallon on fuel used) have on shipments to and from the District terminals?
2. What tax rate would produce enough funds to pay the cost of maintaining and operating the project including major repairs and rehabilitation ?
3. What tax rate would reduce the project benefit-cost ratio to unity?
4. What tax rate would result in a significant diversion of shipments to another transportation mode?

These questions and others may be addressed on a national basis in the study and report scheduled to be completed by 30 September 1981 by the Departments of Transportation and Commerce in response to an item in the 1978 Inland Waterways Revenue Act. The report will cover possible changes in the form and method of collecting user taxes, the effects of diversions of traffic from the inland waterways to other transportation modes, policy relating to future navigation improvements, considerations relating to regional and national effects, and other concerns. However, the effects of the user tax and possible tax increases may differ materially from one section of the waterway to another, justifying a preliminary determination at this time of the most probable effects on the 9-foot channel project in the GREAT I area.

The intent of the tax on fuel used in commercial transportation on inland waterways is to establish a trust fund available for construction of replacement and rehabilitation projects on the waterways. However, other measures under consideration for several years would provide for recovery of up to 100 percent of the cost of operating and maintaining the system and 50 percent of the costs of future construction on the system.

The response of the waterway operators to the tax is unpredictable. The industry would have several options, particularly if the tax were not increased. First, the operators might be able to absorb the tax without increasing transportation rates by adopting economies in operation. Second, part of the tax might be absorbed and the remainder recovered by increasing rates. Finally, the entire tax burden might be passed on to the shipper through increased rates. The shipper, in turn, would have similar options to absorb or to pass on all or part of the increased transportation costs, either in the form of an increased cost to the buyer on the receiving end or a lower price to the seller on the production end. Most probably, the tax burden would be distributed throughout the chain from producer to consumer and adjustments made in accordance

with prevailing market controls. In the case of grain shipments, an increased user fuel tax might be passed on through the chain to the farmer who would then obtain an increase in his Federal subsidy payment with the result that a part of the Federal savings in costs of waterway maintenance would be lost in increased subsidy payments to farmers. This example is an extreme case, and, no doubt, other regulatory or market controls would alter the results, but it serves to illustrate the complex nature of the market response to a tax affecting one link in a long chain.

In general, increases in the fuel tax would discourage the normal growth in the water shipment of some commodities and would divert other shipments to a lesser-cost mode of shipment. The net result would be a reduction in transportation savings for those commodities continuing to move by water and a diversion of others as the tax eliminated the savings. In this particular period, inflation and rapidly rising fuel costs are causing frequent changes in transportation costs and corresponding rates. As a result, any analysis applies only to the specific time period on which the study is based and is reliable only insofar as the data base is sound.

Other forms of user charges have been suggested, including a fee for each passage through a lock, possibly adjusted to reflect the time required for each passage. Proponents of these charges note that operation and care, rehabilitation, and replacement of the locks and dams are major costs of the waterway system and that users should pay all or part of these costs. Opponents argue that recreation craft use the locks in some areas almost as much as commercial tows and that they should share in the fee payment. Other concerns cited in opposition include the complex accounting system required, the disproportionate burden on shipments originating from or destined for terminals at the upper ends of the system, and the pressure to avoid or reduce lockage fees by extending overland commodity movements to more downstream terminals. The latter would cause congestion in new areas on the waterway and would reduce the revenue expected while Federal maintenance and operation costs of the locks and dams were not reduced.

The fuel tax, effective after 30 September 1980 at \$0.04 per gallon and increasing periodically to \$0.10 per gallon by 30 September 1985, will provide an average annual revenue to the Federal Government of about \$5.7 million. The portion of the tax assignable to the St. Paul District has been estimated at \$1.2 million which reduces the average annual transportation savings from \$26.9 million to \$25.7 million, representing about a 4.5-percent reduction in project benefits. Although the tax may be a significant added burden to waterway users, shipment costs would not be increased to a point where shipments would be diverted to a competing traffic mode nor would the economic feasibility of the St. Paul District portion of the waterway be greatly affected.

#### SUMMARY

This analysis, which is based on 1976 shipments to and from St. Paul District terminals, indicates that the shipments in that year totaled about 17.7 million tons. Downbound farm products constituted about 37 percent and coal (both upbound and downbound) about 27 percent of the total shipments. Nonmetallic minerals and petroleum products constitute about 16 and 13 percent of the total, respectively. Chemical products and scrap iron and steel products make up the balance of the shipments. Recognizing the restrictive effect at lock and dam 26 until 1987 when the new enlarged lock will be in operation, shipments are estimated to increase to about 33.4 million tons by 2029. Detailed records of terminal-to-terminal shipments by commodity group are not available for 1979, but the 1979 total has been estimated at 19.45 million tons.

The St. Paul District share of the total transportation savings, based on the 1976 shipment record and transportation rates at 1978 price levels, on the current traffic is estimated at \$21.7 million or about \$25.3 million at 1979 estimated shipments and price levels. This adjustment and estimates of savings on future traffic assume that all shipments will increase proportionately, an unlikely development but probably the best assumption that can be made. Without considering the existing user fuel tax, currently at 4 cents per gallon and scheduled to escalate to 10 cents per gallon by 1984, the present worth (1979) of the savings on future traffic would be about

\$1.1 million or a total savings of about \$26.9 million. With the authorized fuel tax, average annual benefits are estimated at \$25.8 million at 1979 price levels.

The sensitivity analysis indicated that, depending on which of several possible assumptions might be adopted, the average annual benefits creditable to the St. Paul District could vary from \$26.7 million to \$25.4 million, leading to the conclusion that the estimate of benefits of \$25.8 million is reasonable. The sensitivity of the estimated benefits to problems associated with lock congestion, fleeting areas, fuel prices, and fuel supplies was discussed and the conclusion is that the adequacy of fuel supplies may be the principal factor affecting the projected growth of future traffic on the waterways. Finally, the effects of the user fuel tax and possible increases in the tax are discussed. The conclusion is reached that the 10 cents per gallon tax would cause no diversion of shipments from the waterway to another traffic mode although the estimated savings (project benefits) might be reduced, depending on the market adjustments to the tax and future rate adjustments to accommodate inflation and rising fuel prices. Estimated project benefits are definitely sensitive to changes in the user fuel tax as well as to many other interrelated variables which are active at this time. Estimated average annual benefits creditable to the St. Paul District portion of the navigation project, based on commercial transportation savings at 1979 price levels, total \$25,754,000, including the reduction resulting from the currently authorized user fuel tax.

#### EFFECTS OF GREAT I

##### COSTS

Potential increases in the costs of operating and maintaining the 9-foot channel that would result if the First Priority or GREAT I Program (see Appendix A) were implemented were estimated. The relative priorities of the recommendations, time frame, and availability of funds affected the estimates of average annual costs.



Several conditions were used to make the estimates, taking into account that priorities, time frames, and the studies and work accomplished will vary as implementation plans for the respective agencies are developed and approved and funds and staff are provided. In most cases, the cost estimates in the GREAT I report were used. Higher cost estimates were used where additional analysis indicated they would be appropriate.

For the First Priority Program, capital investments (such as purchase of equipment and purchase of land to allow implementation of the CMP (Channel Maintenance Plan)) were assumed to be made over the first 5 years. After that time, the 9-foot channel would be operated and maintained in general compliance with the CMP. Other activities recommended in the First Priority Program but not part of the CMP would be accomplished in an orderly fashion over the next 10 to 15 years. The order of implementation was only used to determine average annual cost increases. The relative order of priorities will be coordinated with Federal and State agencies and other interests as necessary to ensure that future budget requests consider the overall priorities. Under the First Priority Program, average annual costs are expected to increase about \$3 million per year.

For the GREAT I Program, the assumptions for implementation of the CMP under the First Priority Program were used. The other recommendations were assumed to be implemented within a 15- to 20-year period. Average annual costs are expected to increase about \$9 million per year with the GREAT I Program.

These cost increases are only for the St. Paul District, Corps of Engineers; increased costs for other agencies are not included. The estimates are presented on an average annual basis for purposes of comparison. Actual costs in any individual year or series of years could differ substantially, especially in the early years of implementation when additional lands, work at temporary placement sites, and other features could require much higher investments. Additional funding would be planned through the operation and maintenance budgeting process; requests for funds for specific items would be submitted on an annual basis.

## BENEFITS

Commercial navigation, fish and wildlife, and recreation benefit from the 9-foot channel, Upper Mississippi River Wild Life and Fish Refuge, and associated facilities. The 9-foot channel was authorized as a single-purpose project; therefore, only benefits for commercial navigation are reported and recorded. Average annual benefits are \$21.8 million.

Other benefits need to be quantified. The Upper Mississippi River is the GREAT L area is widely recognized for its high quality fish and wildlife and recreation resources. However, benefits to these resources from the project have been expressed in qualitative terms. Some quantitative estimate is needed to compare these benefits to those for commercial navigation.

Although direct measurement of the value of fish and wildlife resources would be very valuable, it is extremely difficult and, at this time, unobtainable because of such factors as lack of firm data, shortage of resources to obtain the data, and lack of agreement on an appropriate method to use to make an estimate. An indirect method to use is the alternative cost method. The alternative cost to obtain the fish and wildlife benefits can be determined by estimating the cost to operate and maintain the system exclusively for fish and wildlife. In the report Cost Allocation-Case Study, September 1980, separate costs were given for operation and maintenance of the 9-foot channel for 1975 through 1979 exclusively for fish and wildlife, recreation, and commercial navigation. The average annual cost of the project for only fish and wildlife was about \$3.2 million. The operation of the Upper Mississippi River Wild Life and Fish Refuge costs about \$600,000 per year.<sup>(1)</sup> Thus, the cost to operate the 9-foot channel and refuge only for fish and wildlife is about \$3.8 million. This estimate is not a true average annual cost because it does not reflect amortized capital costs nor is it based on a comprehensive analysis of how the project operation and features might be modified if it were operated exclusively for fish and wildlife. However, it represents a minimum cost for such a single-purpose project.

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(1) Figure is based on data furnished by the U.S. Fish and Wildlife Service.

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IMPLEMENTATION FOR GREAT 1 STUDY(U) CORPS OF ENGINEERS  
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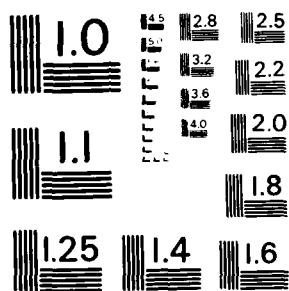
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If benefits are assumed equal to the costs, the benefits would also be \$3.8 million. As stated in the GREAT I report, the fish and wildlife resources of the Upper Mississippi River are an extremely important part of the national natural resource base and improvements in the system are justified for fish and wildlife purposes. The significant benefits are not quantifiable, but the annual benefit of \$3.8 million can be considered a minimum. In all probability, if these benefits could be quantified, they would be much greater. Full implementation of the GREAT I recommendations would increase fish and wildlife and environmental benefits; however, the amount of the increase is not quantifiable. The First Priority Program would increase long-term benefits to the fish and wildlife resources; most of the increases would result from implementation actions by agencies other than the Corps.

Water-based recreation benefits can be estimated by determining the dollar value for the average annual visitor day for the pools of the Mississippi River. Volume 6 of the GREAT I report, Appendix I, Recreation, presents projections of annual activity occasions for each pool by activity (picnicking, swimming, sightseeing, fishing, boating, waterskiing, camping, hiking, hunting, and snowmobiling) for the years 1975, 1980, 1990, 2000, 2010, 2020, and 2025. Only fishing, boating, and waterskiing were used to estimate an annual recreation benefit because these activities are directly related to the 9-foot channel project. Table E-32 presents annual benefits for 1980 based on the activity occasion estimates of GREAT I. Conversion factors used to obtain the visitor day estimates were selected on the basis of review of recent user surveys. The day use values for each pool were selected on the basis of judgments of the recreation access, quality, and mix of activities available. These day use values are consistent with the Water Resources Council's Principles and Standards. Conservative values were used to reflect the limited involvement of the Corps in recreation. The annual recreation benefit is estimated at \$7.5 million for 1980. Projected future increases in use should be used to develop an estimate of average annual recreation benefits. The additional data in the GREAT I Recreation Appendix or new projections being prepared by the District for its update of the Recreation Resource Master Plan could be used to determine future increases. However, for this report, the 1980 benefit is adequate as a

preliminary estimate of the average annual benefit (the actual average annual benefit would be greater than \$7.5 million). Implementation of the GREAT I recommendations would increase recreation benefits, but the increase is not quantifiable at this time.

Table E-32 - Estimate of annual water-based recreation benefits, 1980

Pool	Activity occasions	Conversion factor	Visitor days	Day-use value	Estimated benefits
U&L SAF	81,000	1.3	62,000	\$1.00	\$62,000
1	85,000	1.5	57,000	1.00	57,000
2	65,000	1.8	36,000	1.25	45,000
3	3,310,000	2.0 - 2.5 <sup>(1)</sup>	-	1.50 - 2.25 <sup>(1)</sup>	2,910,000
4	1,120,000	2.5	448,000	2.25	1,010,000
5	299,000	2.3	130,000	2.00	260,000
5A	367,000	2.3	160,000	1.75	280,000
6	1,140,000	2.5	456,000	2.00	912,000
7	536,000	2.5	214,000	1.80	386,000
8	658,000	2.5	263,000	2.00	526,000
9	783,000	2.5	313,000	2.00	626,000
10	592,000	2.5	237,000	1.80	426,000
Total					7,500,000

(1) The higher conversion factor (2.5) and day use value (\$2.25) were used for the St. Croix River portion of pool 3. The lower values (2.0 and \$1.50) were used on the Mississippi River main stem.

Table E-33 summarizes average annual benefits of the 9-foot channel and Upper Mississippi River Wild Life and Fish Refuge. About \$37 million in benefits are estimated; commercial navigation benefits represent about 70 percent of the benefits. The benefits derived from other purposes are significant and would support additional expenditures to maintain or improve the high quality of fish and wildlife and recreation resources.

Table E-33 - Summary of average annual benefits	
Category	Amount
Commercial navigation	\$25,800,000
Fish and wildlife	3,800,000 <sup>(1)</sup>
Recreation	<u>7,500,000<sup>(1)</sup></u>
Total	37,100,000

(1) Does not reflect actual average annual benefits. Refer to text for qualifications on these estimates.

#### COMPARISON OF BENEFITS AND COSTS

Many of the benefits expected from implementation of the GREAT I recommendations are not quantifiable. Thus, a comparison of costs and benefits does not reflect all the merits of the recommendations. Table E-34 shows a comparison of costs and quantifiable benefits. The comparison shows that the 9-foot channel is justified on the basis of commercial navigation benefits alone except under the GREAT I Program. When fish and wildlife and recreation benefits are included, the 9-foot channel is justified under all the programs even though increases in fish and wildlife and recreation benefits resulting from implementation of GREAT I recommendations are not included.

Table E-34 - Comparison of benefits and costs<sup>(1)</sup>

Item	Amount		
	Basic Program	First Priority Program	GREAT I Program
Average annual costs	\$19,207,000	\$22,200,000	\$28,200,000
Average annual benefits			
Commercial navigation	25,800,000	25,800,000	25,800,000
Commercial navigation, fish and wildlife, and recreation	37,100,000	37,100,000 <sup>(2)</sup>	37,100,000 <sup>(2)</sup>
Benefit-cost ratios			
Without fish and wildlife and recreation benefits	1.3	1.2	0.9
With fish and wildlife and recreation benefits <sup>(3)</sup>	1.9	1.7	1.3

(1) Includes only the costs of implementing GREAT I recommendations associated with Corps programs.

(2) Benefits for fish and wildlife would be greater, but quantified estimates are not available.

(3) Includes \$600,000 in average annual costs to operate and maintain the refuge.

#### COST ACCOUNTING, SEPARATION, AND ALLOCATION

The St. Paul District keeps detailed records on how the funds allocated for a project are spent. The Corps of Engineers Management Information System (COEMIS) offers 35 separate code features which can each be subdivided into many separate subcodes, so that practically each separate expenditure can be identified. This type of cost accounting is essential in the development of a separation and/or allocation of costs by purpose. A brief summary of the accounting of the costs for operation and maintenance of the 9-foot channel project for the period 1975 through 1979 (by fiscal year) and the separation and potential allocation of these costs by purpose will be discussed. This information is summarized from the report Cost Allocation - Case Study, September 1980, compiled by the St. Paul District.



## COST ACCOUNTING

The costs for the operation and maintenance on the 9-foot channel on the Mississippi, Minnesota, and St. Croix Rivers are accounted for under either operations or maintenance. There are 19 subcategories under operations and 16 under maintenance. The distribution of costs by the major areas for the period 1975 through 1979 are shown in figure E-7. Lock, dam, and reservoir operations account for 41 percent of the costs, channel dredging 20 percent, and lock maintenance 10 percent, with these three areas accounting for a total of 81 percent of the money spent.

Dam maintenance, engineering support, recreation management, and other items constitute the remaining 29 percent.

## COST SEPARATION

The costs can also be separated by the purposes for which costs are actually incurred. Although the project was originally authorized solely for commercial navigation, recreation and fish and wildlife also benefit from it. Some costs are incurred only for a specific purpose (for example, construction and maintenance of recreation facilities, opening of a back channel area to improve flow for the fishery habitat, or the dredging of the navigation channel to ensure a depth of at least 9 feet for passage of commercial traffic). Most costs cannot be identified as serving a specific purpose, but serve more than one purpose. Maintenance and operation of the locks serve both commercial navigation and recreation. Maintenance of the dams serves fish and wildlife, recreation, and commercial navigation. These costs, which cannot be identified for only one purpose, can be labeled nonspecific costs. The breakdown of the specific and nonspecific costs for fiscal years 1975 through 1979 is shown in table E-35. Most of the costs (70.7 percent) are nonspecific. Of the specific costs, 26.3 percent are related to commercial navigation and 3 percent are related to recreation, fish and wildlife, or planning.

Figure E-7 - Breakdown of operation and maintenance costs for 9-foot channel within the St. Paul District, 1975-1979

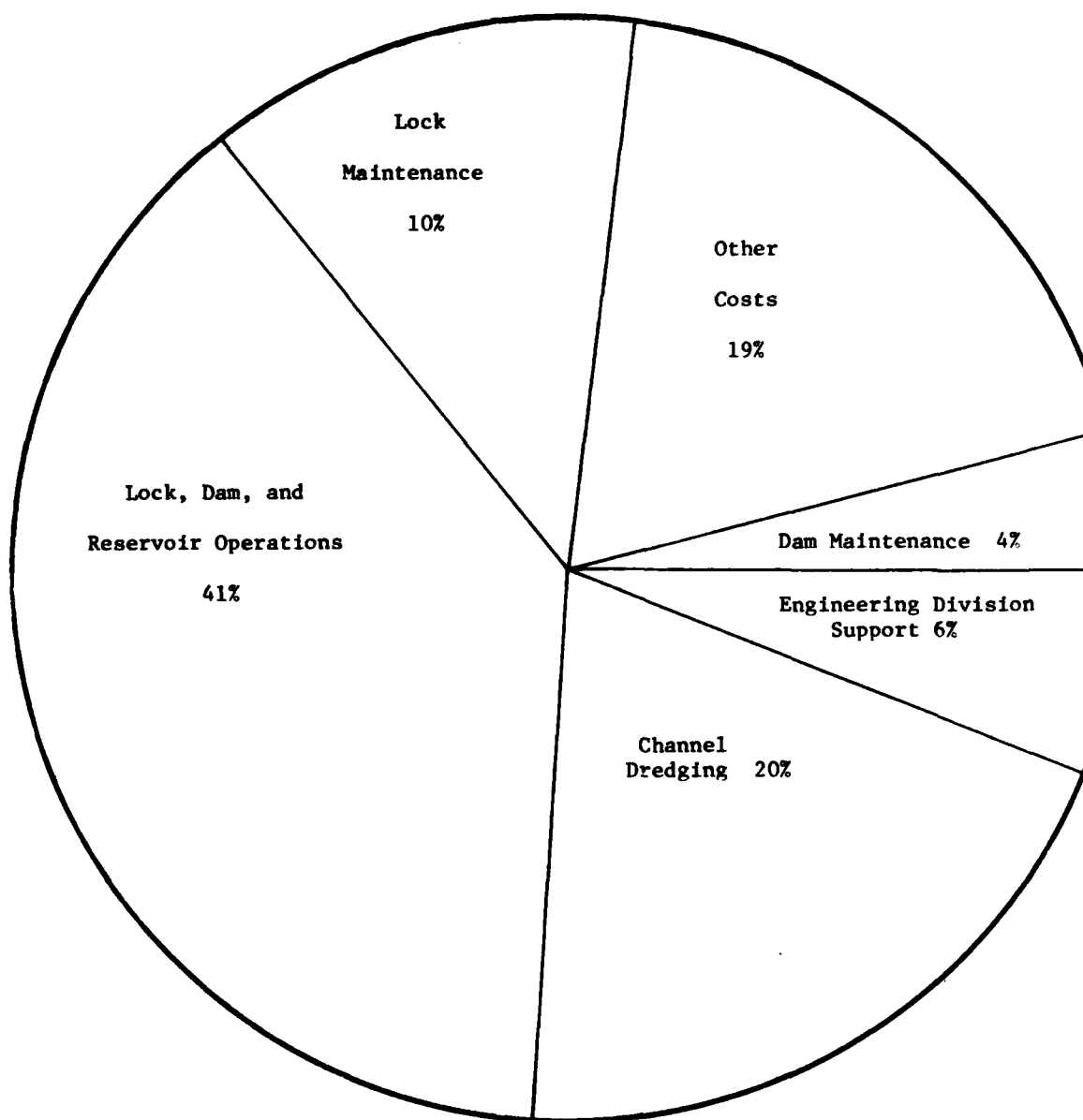


Table E-35 - Summary of specific costs identified by major purpose

Item	1975	1976	TQ	1977	1978	1979	Total	Percent
Total costs	\$8,703	\$9,619	\$3,624	\$10,693	\$13,870	\$12,230	\$58,739	100.0
Specific costs	(2,366)	(2,812)	(1,224)	(2,503)	(4,769)	(3,522)	(17,196)	(29.3)
Recreation	122	177	49	160	418	252	1,178	2.0
Fish and wildlife resources	52	1	10	60	274	11	408	0.7
Planning studies	0	48	0	0	148	0	196	0.3
Commercial navigation (subtotal)	[2,192]	[2,586]	[1,165]	[2,283]	[3,929]	[3,259]	[15,414]	[26.3]
Channel maintenance	1,627	1,814	915	1,346	2,583	3,009	11,294	19.3
Soundings and surveys	170	51	58	254	83	335	951	1.6
Environmental quality studies	267	50	21	136	121	33	628	1.1
Other	128	671	171	547	1,142	-118	2,541	4.3
Non-specific costs (total costs minus specific costs)	(6,337)	(6,807)	(2,400)	(8,190)	(9,101)	(8,708)	(41,543)	(70.7)

## COST ALLOCATION

Several methods can be used to allocate the nonspecific costs (or perhaps more appropriately labeled as joint costs) to each purpose so that total project costs can be equitably distributed. Two methods were tested by the St. Paul District to determine the potential applicability of these methods to allocate the costs for the 9-foot channel project, based on the review of the period 1975 through 1979:

(1) a modified version of the Use of Facilities and (2) Separable Cost-Remaining Benefits.

Table E-36 highlights some of the basic differences in philosophy, methodology, required input, and areas of sensitivity of the two methods.

Table E-36 - Summary of features of two cost allocation methods

Factor	Use of Facilities (modified version)	Separable Costs-Remaining Benefits
1. Relative importance of the purposes to which the costs are allocated	The costs are allocated to the purposes based on the principal of "user pays." If costs are incurred specifically for a purpose, they are allocated to that purpose. The remaining costs are distributed based on the use of the facility where a marginal effort or cost can be identified with serving the purpose. If no extra costs or efforts are incurred for a purpose, the purpose is not allocated a cost, in essence getting a "free ride." With the project being authorized for commercial navigation, the project would be operated primarily for commercial navigation and the costs would be allocated primarily to commercial navigation unless they can be directly related to serving another purpose. This method places first priority on commercial navigation and low priority on fish and wildlife and recreation.	The costs are allocated to purposes based on the national importance of the project outputs. Each purpose pays its separable costs as well as a share of the remaining (or joint) costs on the basis of the significance of the project outputs by purpose. This method treats the purposes more directly on the basis of what is required to get the desired output if the other purposes were not being served. This method is based on the premise that each purpose's output is desired and that it should share in an equitable distribution of the overall project's cost on the basis of its output. This method would tend to treat the project purposes more as equals, rather than assigning priorities to purposes.
2. Methodology/basic steps involved in the allocation process	<ol style="list-style-type: none"> <li>Identification of purposes which require a specific cost or a marginal cost.</li> <li>Separation of the specific costs to purposes.</li> <li>Allocation of the nonspecific costs to purposes based on a measurement of use of the facility by or for each purpose.</li> </ol>	<ol style="list-style-type: none"> <li>Identify the components of the total costs.</li> <li>Determine which costs are specific purpose costs.</li> <li>Estimate the cost of maintaining the single-purpose output.</li> <li>Estimate the cost of maintaining the project for the other purposes, except for one.</li> <li>Determine the separable and the joint costs.</li> <li>Allocation of the joint costs is made on the basis of the percentage of remaining benefits by purpose after consideration of the separable costs to obtain those benefits.</li> </ol>
3. Required data for input	<ol style="list-style-type: none"> <li>Identification of costs for specific purposes (available through cost code separation in COEMIS).</li> <li>Measurement of the use of the facility (available through the PMS which records data on vessels moving through locks).</li> </ol>	<ol style="list-style-type: none"> <li>Identification of specific purpose costs (available through cost code separation in COEMIS).</li> <li>Estimate of costs required to operate and maintain the project for a single purpose and for dual purposes. (Can be developed through the information available in COEMIS.)</li> <li>Estimate of the benefits (available based on shipping savings for commercial transportation; for fish and wildlife and recreation are estimated to be equal to single-purpose cost for that purpose).</li> </ol>
4. Areas of sensitivity of the analysis	<ol style="list-style-type: none"> <li>The unit of measurement for determining use of a facility is discretionary. Displacement, number of lockages, and time of lockage are candidate factors. The time of lockage appeared to be the most reasonable for the St. Paul District reach.</li> </ol>	<ol style="list-style-type: none"> <li>The estimating of the single-purpose and dual-purpose costs are not necessarily as precise as the overall project cost.</li> <li>The allocation of the joint costs depend on the estimate of benefits to a purpose only if the benefits are less than the single-purpose cost for that purpose. If the benefits are less than the single-purpose costs, fewer joint costs would be allocated to that purpose.</li> </ol>
5. Limitations on use/applicability to St. Paul District	This method could be used in the St. Paul District. Its applicability to all reaches of the river is uncertain. Changes in the allocation of costs may be required on the basis of actual usage for any given year.	This method could be used in the St. Paul District. It would have potential for use over all river reaches. Although it can be readily modified to recognize project purpose changes, because it is based on an average condition for the project, the allocation would not change noticeably unless there were major purpose changes.

Each method has its advantages and disadvantages; however, both methods were capable of producing reasonable allocations. The greatest difference between the methods was in the basic philosophy and underlying theory. The Use of Facilities method established a priority for the purposes and allocated accordingly. The Separable Costs-Remaining Benefits method considered the purposes with respect to their recognized national outputs and then allocated joint costs accordingly.

The two methods were applied to the costs of project operation and maintenance for fiscal years 1975 through 1979. The results are shown in table E-37; commercial navigation was allocated from 65 to 78 percent of the costs, recreation from 20 to 23 percent, and fish and wildlife from 1 to 11 percent. Also, on the basis of a comparison of dredging costs prior to 1974, it could be determined that about 17 percent of the costs were attributable to the Federal and State environmental quality requirements and most of these costs were associated with the maintenance dredging for the 9-foot channel. These costs are included in the allocation to commercial navigation. Although these results should be considered only as preliminary, they do establish a reasonable range for which the purposes would be allocated to their share of project costs. The theory of the method with respect to the purposes, the reliability of the allocation, and the potential for use throughout the system should be the principal considerations when selecting the method to be used. The results of the allocation will reflect the philosophy of the method.

Table E-37 - Summary of cost allocations

Purpose	Percent of costs allocated to purpose for average of 1975 through 1979	
	Modified Use of Facilities	Separable Cost-Remaining Benefits
Commercial navigation	78	65
Recreation	20	23
Fish and wildlife	1	11
Planning studies		<u>1</u>
Total	100	100

APPENDIX F

LETTERS OF COMMENT  
AND RESPONSES TO COMMENTS

UPPER MISSISSIPPI RIVER AREA  
(HEAD OF NAVIGATION TO GUTTENBERG, IOWA)

ST. PAUL DISTRICT  
U.S. ARMY CORPS OF ENGINEERS

JUNE 1981

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## APPENDIX F

### LETTERS OF COMMENT AND RESPONSES TO COMMENTS

#### INTRODUCTION

In December 1980, the draft of this report was submitted for review to the agencies that had actively participated in the GREAT I study. Comments received are presented and discussed in this appendix. The comments are summarized, the major concerns are addressed, and each letter received and the discussion of the concerns raised are presented.

#### SUMMARY OF COMMENTS

##### ENVIRONMENTAL PROTECTION AGENCY

No additional comments.

##### DEPARTMENT OF THE INTERIOR - FISH AND WILDLIFE SERVICE

The Fish and Wildlife Service expressed concern over the lack of effective communication and coordination between the Corps and the Service on management of river resources. Of particular concern is the coordination of the master planning activities of both agencies. The Service supports further study and coordination of several of the recommendations of GREAT I which relate to the fish and wildlife resources identified for Corps implementation.

##### DEPARTMENT OF TRANSPORTATION - COAST GUARD

The Coast Guard provided comments in three letters. The first letter presented concerned the safety of marine commerce, with special emphasis on a more rigorous evaluation on the amount of overdepth dredging deemed prudent for safe river transportation. In its second letter, the Coast Guard wanted to extend the definition of emergency dredging to include

conditions when the channel is impassable even though a vessel has not gone aground. The third letter provided comments on all aspects of the implementation report. A principal theme of the Coast Guard views is that the Channel Maintenance Plan (CMP) is not complete and not acceptable. Insufficient flexibility, faulty assumptions, and insufficient economic evaluation were listed as major shortcomings. The Coast Guard feels the CMP should be evaluated further before it can be adopted as an implementable plan.

#### IOWA DEPARTMENT OF TRANSPORTATION

The Iowa Department of Transportation does not find justification for the First Priority Program, particularly the CMP. It cannot support a plan it believes does not meet the minimum safety requirements of navigation. The Department was also concerned about the increased cost of maintaining the navigation channel as proposed under the GREAT I plan and feels the increase is not reasonable. It also feels that most of the problems which brought about the need for GREAT have already been solved through the interdisciplinary management approach.

#### IOWA CONSERVATION COMMISSION

The Iowa Conservation Commission endorses the First Priority Program, but feels more attention should be given to the recreation and fish and wildlife benefits to be achieved by implementation of the GREAT I recommendations. It views the CMP as a moderately flexible guide that provides a reasonable level of protection for the environment and believes that placement sites identified through the GREAT I process would provide a starting point for placement decisions.

#### MINNESOTA DEPARTMENT OF TRANSPORTATION

Implementation of the CMP as described in the GREAT I documents is not acceptable until some of the recommendations are modified through additional coordinated efforts by Federal and State participants.

Major concerns center around the effects of reduced-depth dredging on the safety and increased costs to commercial navigation and the lack of economic considerations in the development of the CMP. The Department also feels that all concerned agencies should be represented in any continued coordination efforts.

#### MINNESOTA POLLUTION CONTROL AGENCY

The Pollution Control Agency generally supports St. Paul District plans to implement GREAT I recommendations. It feels that additional detail is required before a definitive position can be taken on the actual merits of individual recommendations. It cannot guarantee approval of permit applications to use the dredged material placement sites in the GREAT I CMP when variances from State rules are proposed. The definition of the project depth as proposed by GREAT I does not necessarily resolve any present controversies.

#### MINNESOTA DEPARTMENT OF NATURAL RESOURCES

The Department supports implementation of the First Priority Program and considers it an essential minimum level program for continued operation and maintenance of the 9-foot channel. More attention should be given to the use of new equipment. Control of sediment at the source is among the highest priority items. Corps implementation of GREAT I recommendations for channel maintenance should have higher priority than nonchannel maintenance recommendations. The Department views the acquisition of private lands for placement sites as a necessary element of continued channel maintenance.

#### WISCONSIN DEPARTMENT OF NATURAL RESOURCES

The CMP proposed under the First Priority Program is acceptable. Although the CMP needs to be flexible, the Department does not feel that the plan should undergo any major reconsiderations. It is working to modify Wisconsin laws to allow variances for dredged material placement

sites on the basis of site-specific circumstances. It supports separation of funds for nonchannel maintenance recommendations so that the funds cannot be transferred to the dredging account. It feels authority to implement actions for fish and wildlife and recreation should be part of the First Priority Program.

#### WISCONSIN DEPARTMENT OF TRANSPORTATION

The implementation report represents a reasonable approach to ensuring that the recommendations of GREAT I are recognized and implemented; it deals with budget constraints and provides options to be pursued if more funding is made available.

#### UPPER MISSISSIPPI WATERWAY ASSOCIATION

The association feels the CMP (which includes reduced-depth dredging and reduction in the frequency of use of hydraulic dredges) will result in the loss of hydraulic dredging capability and is a potential waste of Federal money. Loss of hydraulic dredging capability would eliminate the excellent emergency response available at this time. The association does not feel that commercial navigation interests should be asked to pay costs incurred for environmental considerations. It feels that funds available for operation and maintenance of the 9-foot channel will be reduced and supports the reduction if the amounts of money for environmental considerations are reduced. It is also very concerned about acquisition of private lands for dredged material placement if the landowners do not want to sell the land.

#### CARGO CARRIERS, INCORPORATED

Cargo Carriers, Incorporated, is concerned over the proposed policy change that would allow the Corps to acquire privately owned placement sites, particularly if the policy is applied to sites along the Minnesota River.

## DISCUSSION OF MAJOR CONCERNS

Several topics were of common interest to many of the community agencies, even though one agency's view may be the opposite of another. To facilitate review and understanding of these concerns, they are presented in this section by topic. The concerns presented are:

1. Reduced-depth dredging and safety of commercial navigation.
2. Acquisition of private lands for dredged material placement sites.
3. Fish and wildlife and recreation enhancement.
4. Coordination with the Upper Mississippi River Wild Life and Fish Refuge.
5. GREAT I CMP.

### REDUCED-DEPTH DREDGING AND SAFETY OF COMMERCIAL NAVIGATION

#### GREAT I Recommendation

GREAT I recommended (in Action Item 4) that dredging quantities should be minimized through:

1. Reduced-depth dredging if technically supported.
2. Maintenance of minimum channel widths suitable for commercial navigation.

The potential for increasing dredging frequency, impacts on the transportation industry, and demand for dredged material in the area would be considered.

### Agency Concerns

The Coast Guard, Iowa and Minnesota Departments of Transportation, and Upper Mississippi Waterway Association are concerned that reduced-depth dredging would result in a channel that is unsafe for commercial navigation. The Coast Guard recommends deferring reduced-depth dredging until the amount of overdepth dredging needed to ensure safe river transportation is determined.

### Background

Historically, the St. Paul District has initiated channel maintenance when the channel depth decreased to less than 11 feet below low control pool (LCP). Before 1973, dredging was done to a depth of 13 feet below LCP except during peak dredging periods (such as 1965 and 1969) when lesser depths were dredged to reestablish a 9-foot channel.

Once the depth decreases to 10 feet, the channel can quickly close to depths less than 9 feet. This fact was illustrated at Reads Landing in 1974 and mile 583 in the Rock Island District in 1980. Both instances were well documented showing that, because of subsequent shoaling, navigational impact, limits of surveying accuracy, or a combination of these factors, channel depths deteriorated from 10 feet to less than 9 feet in a few days.

On the basis of this experience, dredging is initiated when channel depths at LCP reach 10.5 feet. This depth represents a 0.5-foot increase in channel shoaling before dredging compared to dredging practices before 1973. Navigation has proceeded without closures when the channel depth was 11 feet or greater. During the history of the St. Paul District, channel maintenance dredging has not been initiated at a site with minimum channel depths greater than 11 feet.

Dredging deeper than 11 feet has been done to provide subsequent shoaling capacity and reduce the cost of high frequency maintenance dredging. During the GREAT I study, the St. Paul District experimented with varying the

amount of advance maintenance dredging (the 11- to 13-foot increment). In some instances, the frequency of dredging did not increase; in others, the frequency increased and no savings in average annual dredging volumes occurred. With site-specific experience, the St. Paul District is better able to select dredging depths that minimize the cost and volume of dredging without encroachment on the minimum channel depth.

A reliable navigation channel is essential to the safety of commercial navigation. In the GREAT I area, LCP is the level that has almost a 100-percent chance of occurrence. Most of the time, pool levels are greater than LCP. Dredging and channel depths are normally referred to LCP, so navigation depths are generally greater than the depth referred to for programming dredging at a given location.

The amount of shoaling required to affect navigation following 13-foot dredging is greater than that following 11-foot dredging. The integrity of the channel following 11-foot dredging is susceptible to higher frequency hydrological events. Because of this tendency, the Corps has doubled and at times tripled channel condition monitoring. The capability of equipment to respond to channel maintenance demands was assured.

Many hazards to commercial navigation exist on the river. The 9-foot channel does not imply a hazard-free system nor the most efficient channel for navigation, but rather a channel that allows navigational use by vessels drafting up to but not exceeding 9 feet. This channel is to be maintained within fiscal and physical limitations of the equipment required to dredge the river in compliance with the appropriate laws and regulations that govern the work.

#### St. Paul District Position

The St. Paul District must dredge before the channel depth reaches 10 feet to ensure a channel depth of 9 feet. Depths of 11 feet appear stable without significant shoaling. Advance dredging deeper than 11 feet will be considered on a site-specific basis to ensure the integrity



of navigation against subsequent shoaling and to minimize the cost of dredging. This maintenance procedure will be followed to ensure a suitable channel depth with navigational use by vessels drafting up to but not more than 9 feet. All of the considerations presented in the rationale discussion for the GREAT I recommendation (page VII-13 of GREAT I Main Report) would be used in the decision as to the amount of advance maintenance dredging to be accomplished at each site. Approaches to rigid structures will continue to be dredged to 13-foot depths.

The St. Paul District intends to evaluate the potential for reducing dredging volumes on a case-by-case basis. Measures considered will include reduced-depth dredging in accordance with GREAT I recommendations. The relationship between specific depths and channel widths necessary to ensure navigational safety will be investigated further. However, maintenance dredging has never been initiated before the channel depth reached 11.0 feet below LCP. The controlling channel depth criterion throughout the system has been 11 feet or less. Therefore, the primary concern is the depth and width of initiating maintenance rather than the depth of dredging beyond 11 feet.

The amount of advance maintenance dredging will depend on channel condition monitoring capability, dredging equipment capability and availability, historical experience, navigational safety, reliability of technical evaluation, demand for dredged material, and appropriate laws and regulations. Initiation of dredging will depend on the time needed to complete dredging once the need has been identified. In all cases, dredging will be done to ensure the 9-foot channel controlling dimensions are achieved.

## ACQUISITION OF PRIVATE LANDS FOR DREDGED MATERIAL PLACEMENT SITES

### GREAT I Recommendation

The GREAT I recommendation (Policy/Funding Item 6) and the CMP recognize that many of the recommended placement sites are owned by private interests. In some cases, they may not be willing to have dredged material placed on their property. In these situations, the Corps would have to purchase the rights to place the dredged material on the property through an easement or fee title acquisition. In some cases, the owner may not want to sell either the easement or the title and condemnation may need to be used.

### Agency Concerns

Commercial navigation interests are concerned that the acquisition of private lands for dredged material placement may remove lands from private ownership and adversely affect future development plans of these private interests. The Iowa Department of Transportation indicated that the costs and uncertainties of acquiring the private lands are difficult to justify. The Minnesota and Wisconsin Departments of Natural Resources feel that easement or fee title acquisition of privately owned placement sites is needed at many locations.

### Background

Placement sites for the Minnesota River and Upper St. Anthony Falls pools dredging are furnished by the local sponsor. Corps purchase of land is not an issue for material from these dredge cuts. Placement sites for material from the remainder of dredge cuts in the St. Paul District (in pools 10 through Lower St. Anthony Falls and the St. Croix River) must be furnished by the Corps. Many of the GREAT I identified placement sites are not owned by the Corps.

When the placement sites must be furnished by the Corps, they are selected considering the available equipment and its capabilities in relation to the job requirements, the compliance and evaluation of the site in accordance with the Clean Water Act and other applicable laws and regulations, and the availability of the sites.

Potential placement sites fall into several categories of availability and are listed below in the relative order of preference if other evaluation factors are equal:

1. Public ownership - owner willing.
2. Private ownership - owner willing (without charge).
3. Private ownership - owner willing (payment required).
4. Public ownership - owner unwilling.
5. Private ownership - owner unwilling.

All historic placement sites in the St. Paul District have fallen into the first two "owner willing" categories because of the relative abundance of land in Federal ownership and the desire of private landowners to receive the sandy dredged material free of charge. But most of these sites are wetlands.

Current selection of placement sites includes the use of criteria given in the Clean Water Act which require compliance with State water quality laws. Also, other Federal laws and executive orders require consideration of wetland, floodplain, and other values. Land originally acquired for the project in the St. Paul District did not include the consideration of placement sites for dredged material using current Federal and State criteria. In many cases, although the owners of public and private lands may be willing to accept dredged material, the placement may conflict with current Federal or State laws governing placement of the material. In these cases,

placement rights may have to be acquired by the Corps either through easement or fee title purchase to find an alternative placement site that would be in compliance with Federal laws. However, low funding priorities and lack of approval of the acquisition of such lands have restricted the options when evaluating compliance with the Federal and State laws and orders, executive orders

#### St. Paul District Position

This issue does not apply to the Minnesota River and Upper St. Anthony pools. However, in the other pools, many of the placement sites in the CMP and suitable alternatives are privately owned. Purchase of rights to allow placement of dredged material on these sites is essential. Approval of this purchase and allocation of funds are required by the Corps of Engineers. The Corps has authority to purchase the lands. Funding would generally be at Federal expense. Long-term easements would be acquired whenever possible; however, in those cases where long-term easements would not meet the requirements of anticipated placement needs, fee title acquisition would be considered. Private lands would be condemned only if other acceptable options prove unsuccessful.

#### FISH AND WILDLIFE AND RECREATION ENHANCEMENT

##### Great I Recommendation

GREAT I recommended that Congress give the Corps of Engineers more definitive authority in the area of and funding for fish and wildlife conservation and recreation enhancement (Policy/Funding Item 11).

##### Agency Concerns

The Fish and Wildlife Service is concerned that the Corps recognize that any of its efforts in this area will require coordination with, and in some cases approval by, the Service and the appropriate State(s). The Wisconsin Department of Natural Resources is concerned that the St. Paul District is not pursuing to the fullest extent possible efforts to implement this GREAT I recommendation (Policy/Funding Item 11) and other enhancement measures recommended by GREAT I.

## Background

The St. Paul District has two procedures for fish and wildlife and/or recreation enhancement. The first is through its ongoing operation and maintenance (O&M) program. Dredged material can be placed for enhancement at the time of dredging if costs and other impacts are not excessive when compared to normal O&M procedures. Past or present adverse effects directly attributable to O&M practices can be mitigated (for example, through opening side channels plugged by dredged material, revegetating placement sites, or putting culverts through dam embankments). The second procedure is under the authorities provided by the Federal Water Project Recreation Act (Public Law 89-72) and the Code 710 program.

Under both authorities, a local sponsor is required to pay one-half the costs for the detailed design and construction of the project. Conceptual planning and design generally do not require cost sharing. Other requirements are that the project must be on Federal property and the local sponsor must assume full responsibility for any operation and maintenance required. Funds for projects are appropriated separately from the O&M budget.

## St. Paul District Position

The St. Paul District will continue to operate under current authorities and will enhance fish and wildlife and/or recreation where possible during normal operation and maintenance. The Corps will also continue to mitigate adverse effects attributable to O&M actions when funds are available.

The Corps intends to be more active in enhancing fish and wildlife and/or recreation under its cost-sharing authorities (Public Law 89-72 and Code 710 Program), including facilitating the identification of local sponsors for enhancement projects, especially those recommended by GREAT I.

All Corps efforts at enhancement, whether part of normal O&M or separate projects, will be fully coordinated with the appropriate Federal and State agencies. Implementation will comply with applicable laws and regulations.

The Corps does not intend to pursue changes in Federal cost-sharing policies to make it easier for local sponsors to participate in enhancement projects. The Corps' legislative drafting service will be available to Congressmen who wish to pursue this issue. Current policies under Public Law 89-72 and the Code 710 Program are a deterrent to local sponsors for projects on the Upper Mississippi River. However, it would be more appropriate and effective for the States to work with their Congressmen and Senators to accomplish changes in this area.

There would be value in having fish and wildlife and recreation enhancement made full project purposes of the 9-foot channel. Accomplishing this would require further evaluation and development of justification in the proper format for forwarding to reviewing level authorities. If the other GREAT I agencies indicate they would like to pursue this matter further, the Corps could take the necessary actions.

#### COORDINATION WITH THE UPPER MISSISSIPPI RIVER WILD LIFE AND FISH REFUGE

##### Discussion

The Upper Mississippi River Wild Life and Fish Refuge covers much of the lower half of the GREAT I study area. Historically, dredged material has been placed on refuge lands. The Fish and Wildlife Service has expressed concern that future placement of dredged material and implementation of other GREAT I recommended actions that affect the refuge must be coordinated with the refuge and be consistent with the refuge master plan (now being prepared).

##### St. Paul District Position

The St. Paul District fully intends to coordinate all of its actions with the Fish and Wildlife Service. If the proposed activity is to take place on refuge lands owned by the Fish and Wildlife Service, the Service would have final approval on the action, provided navigation can reasonably be maintained with viable alternatives. The Service will be requested

to propose alternative sites with justification for modification of the plan where it has objections. If a project is on non-refuge lands or general plan lands owned by the Corps but managed by the Service for fish and wildlife, the impact of the project on the refuge and its consistency with the refuge master plan would be important considerations. However, the Corps' decision on whether to proceed with the project will be based on the overall environmental, social, and economic impacts.

GREAT I CMP

#### GREAT I Recommendation

GREAT I recommended (Action Item 1) that the Corps of Engineers implement the dredged material placement plan proposed by GREAT I. Additional information on the plan is given in the Channel Maintenance Appendix of the GREAT I report.

#### Agency Concerns

Most agencies viewed the CMP as a moderately flexible plan that could be modified on the basis of changed information (acquisition of additional site-specific data that could change how the site will be used or changes in Federal or State laws).

The agencies' views differed between two extremes. Some agencies thought the CMP was too specific and feared that if it were not flexible significant adverse impacts could be inflicted on commercial navigation interests. At the other extreme were those agencies who felt the CMP should be followed as much as possible and not be changed significantly because the environmental trade-off benefits attained through the GREAT I process might be lost by a change in agency posture.

The Coast Guard, Iowa and Minnesota Departments of Transportation, and Upper Mississippi Waterway Association shared the first view. They especially feared that plans for reduced-depth dredging would result in

more channel closures, higher costs from delays in navigation, and reduced safety for commercial navigation. They were also concerned that:

1. Higher operation and maintenance costs would be passed on to commercial navigation interests through waterway user charges.
2. Capability to respond to emergency dredging needs (such as following a major flood) would be greatly reduced and result in delays to commercial navigation if the dredging fleet becomes less reliant on hydraulic equipment.

The Fish and Wildlife Service was concerned that proposed placement sites, even those recommended by GREAT I, be coordinated with and approved by the Service if refuge lands are involved.

The Wisconsin Department of Natural Resources agreed that the CMP must be flexible. But it also pointed out that it does not want to rehash the arguments that arose during the GREAT study and reconsider the GREAT I products.

#### Background

The CMP was developed in an attempt to formulate a long-range plan for dredging and material placement that involved agencies would agree to. This plan would recognize other resource management needs than the navigation channel and comply with current laws. Before the CMP was developed, limited consideration was given to other resource management needs and long-range planning for placement sites was restricted.

The CMP was developed with the best available data; however, in many cases, site-specific information was not sufficient to determine if a site could be used in the manner anticipated at a reasonable cost. In spite of the data deficiencies, the GREAT I Team was reasonably confident that the CMP would be workable and that it represented a fair trade-off of the resources involved. The Team also recognized that the CMP had to be flexible



to accommodate changes that could result from new information. The basis of the plan was to develop more environmentally sound channel maintenance practices. Important assumptions in the development of the CMP were that:

1. Volumes of material dredged could be reduced significantly through reduced-depth dredging.
2. Large volume mechanical dredging units are more cost effective than large volume hydraulic dredging units.
3. The selected placement sites would be available.
4. State permits and/or variances to use the placement sites would be provided as needed.
5. Beneficial use projections were valid.

#### St. Paul District Position

The District recognizes the advantages and disadvantages of the CMP. It believes the goal of the CMP is worthwhile and the work accomplished by the Team in placement site selection should not be lost but should serve as a basis for future site selection. Through the GREAT I process, it became apparent that a plan for material placement is needed if the natural resource values of the river are to be retained. The CMP is an attempt to come up with such a plan. However, many issues need to be clarified before any plan can be labeled implementable.

The St. Paul District plans to conduct additional detailed site-specific evaluations of the GREAT I recommended and alternative placement sites. Use of a proposed site will be coordinated with the ongoing interagency coordination forum and, when necessary, the State agency (or agencies) responsible for issuing permits.

Equipment needed for channel maintenance will be evaluated further. Before a final equipment mix can be determined, water quality standards for effluent must be established. The standards will be a primary consideration in the cost of material placement methods. GREAT I was not able to resolve this issue.

When placement sites are evaluated, potential suitable riverine thalweg placement sites will also be evaluated. If the thalweg sites prove suitable, they will be considered in the development and/or adjustment of the CMP.

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

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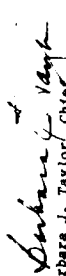
RE: 80-013-190

Dear Colonel Badger:

We have completed our review of the Draft Implementation Report for the Great I Study dated November 1980. We understand that this report when finalized will serve as the St. Paul District's transmittal document for Great I to the Chief of Engineers, and represents the concluding step of the Great I study.

We have no additional comments to make, and wish only to commend all those who participated in Great I for the efforts that they have made toward managing the Upper Mississippi River system.

Sincerely yours,

  
Barbara J. Taylor, Chief  
Environmental Impact Review Staff  
Office of Environmental Review

The St. Paul District looks forward to working with the Environmental Protection Agency to develop criteria for sediment and water quality relating to dredging and material placement (Action Item 9) and implement other GREAT I recommendations discussed in the First Priority Program.



United States Department of the Interior

IN REPLY, REFER TO

FISH AND WILDLIFE SERVICE

TWIN CITIES AREA OFFICE  
600 Federal Building and US Court House  
310 North Robert Street  
St. Paul, Minnesota 55101

FEB 4 1981

Colonel William W. Badger  
District Engineer, St. Paul District  
U.S. Army Corps of Engineers  
1135 U.S. Post Office and Custom House  
St. Paul, MN 55101

Dear Colonel Badger:

This responds to your December 8, 1981 letter requesting our comments on the draft Implementation Report for the GREAT I study. We have reviewed the document and offer the following comments to assist you in preparation of the final version of this important document.

In general, we are pleased with the supportive nature of the report regarding implementation of the GREAT I study recommendations. However, we have several concerns in this matter. Although the report accepts the continuation of the Upper Mississippi River Wild Life and Fish Refuge as a part of the future conditions on the river, there is a general lack of recognition of the refuge and constraints which are dictated by refuge authorities, mandates, and responsibilities regarding a significant regional, national, and international fish and wildlife resource. In several instances, statements and recommendations are made concerning management activities which affect the refuge without an indication of coordination with the Service per our management responsibilities. This also includes lands which are managed under the Cooperative Agreement. We feel the final report should be modified to address these concerns.

We are also concerned with the discussion of fish and wildlife interests in the report. While considerable discussion is afforded to commercial navigation and general recreation interests, the discussion of fish and wildlife resources is limited with little information on projected needs or demands. In this regard, we are troubled with the quantification of fish and wildlife benefits for selected programs and the development of benefit/cost ratios in the absence of supporting data.

Although hunting and fishing are mentioned as part of recreation, the bulk of this attention in the draft report is focused on recreational boating which is relatively compatible with commercial navigation interests. In contrast, declining fish and wildlife resources are not compatible with either navigation or recreational boating at increased levels. Fish and wildlife require a productive life-supporting ecosystem while

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

1. The purpose of the Implementation Report is to outline the St. Paul District's procedure to implement the GREAT recommendations for which it has implementation responsibility. The purpose was not to detail coordination activities. The Corps will coordinate every action to implement GREAT I recommendations with the Fish and Wildlife Service. The Corps intends to continue in the spirit of cooperation developed during the GREAT study.

2. The discussion of fish and wildlife resources has been expanded in the main report.

3. The discussion of the quantification of fish and wildlife benefits and development of benefit-cost ratios has been expanded in Appendix E and modified in the main report. Additional supporting data are provided in Appendix E.

4. The phrase "fish and wildlife and recreation" is not intended to indicate that they always go together. However, they are the two major interests outside of commercial navigation. The phrase "fish and wildlife and/or recreation" has been substituted in several places to indicate that the Corps does not mean both together at all times. In the main report, the statement that expanding recreational use can adversely affect fish and wildlife values has been added.

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
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commercial navigation and recreational boating do not. The report fails to recognize this and seemingly treats fish and wildlife management and expansion of recreational facilities as one through the repeated use of the phrase "fish and wildlife and recreation". Since expansion of non-wildlife oriented recreation has and will continue to adversely impact basic fish and wildlife resources, this matter should be adequately addressed in the final report.

The proposed program actions at times do not seem to be consistent with the spirit of the GREAT recommendations as set forth in the recommendation rationale and overview sections of the GREAT I report. These sections emphasize coordination and cooperation while the draft report seems to propose unilateral action particularly in recommendations dealing with fish and wildlife management and recreational development. Again, Service responsibilities for management of refuge lands need to be recognized and addressed.

The following specific comments will address our above concerns and suggestions in a more detailed manner.

Specific Comments

(1) Page 14, Fish and Wildlife - - Major factors in habitat degradation should also include insufficient planning for and control of industrial/commercial and recreational expansion.

(2) Page 13, Recreation - - Although present recreational activity is dependent upon the high-quality natural setting, to include fish and wildlife resources of the Upper Mississippi River, much of this use can conflict with the maintenance of that high quality. This is particularly the case with regard to refuge lands and management objectives and will become an increasing problem with increasing recreational use. This matter should be recognized in the final report.

(3) Page 14, Table 5 - - The source of the recreation activity data should be referenced.

(4) Sediment and Erosion - - The statement that sediment and erosion are the "most" pervasive and damaging problem is debatable. We suggest "most" be changed to "an important". For example, creation of marshland by sedimentation, a natural river process, can provide habitat benefits for certain species. Other equally important problems are competing uses for the river resources and their unlimited growth.

(5) Page 31, Recreation and Fish and Wildlife - - Proposals require coordination with the Service when refuge lands will be affected.

5. See response to comment 1.

6. These factors have been added to the discussions in the main report.

7. A discussion of this point has been added to the main report.

8. The recreation data were developed from GREAT I Recreation Work Group recreational use projections.

9. Sedimentation can have beneficial effects. But the GREAT I Executive Summary also labels it as the most pervasive and damaging problem. Within the context of the GREAT I study, we agree with this assessment.

10. See "Discussion of Major Concerns" section in this appendix (beginning on page P-7).

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

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- (6) Page 35, Recreation and Fish and Wildlife - - Same comment as above.  
(7) Pages 36-37, Recreation and Fish and Wildlife - - Same comment as above.

(8) Page 34, Table 7 - - Information presented in this table is subjective and should be omitted from the final report as presented. Although the original project justification was for commercial navigation, portions of these costs have now been assigned to recreation and fish and wildlife. These costs cannot be supported in any detail. A major inference of the table is that, unlike costs, benefits do not increase beyond the Basic Program resulting in declining benefit/cost ratios. We cannot support this concept and feel that implementation of programs beyond the Basic Program will provide additional benefits to fish and wildlife resources. The problem is in the quantification of these benefits. It is inappropriate to assume benefits will not occur beyond the Basic Program and therefore, we suggest the table and benefit/cost ratios be omitted from the final report and perhaps replaced with statements indicating increased benefits from implementation of programs beyond the Basic Program, even though such benefits cannot be quantified in detail. Without such changes, we feel the information presented in the draft report may be a detriment to implementing programs beyond the Basic Program.

(9) Page 42 - - The statement at the top of the page implies that the Corps intends to manage the entire river for fish and wildlife and recreation, including lands within our refuge. This statement should be changed to reflect management of fish and wildlife and recreation on non-refuge lands. Any management activities affecting refuge lands must be coordinated with the Service and consistent with the refuge master plan.

(10) Page A-4 Action Item No. 1 - - Use of refuge lands for dredged material placement should be with the coordination and approval of the Service.

(11) Page A-6 Action Item No. 5 - - The main concept of the recommendation, effort in dredging equipment, does not appear to be addressed in the program actions.

(12) Page A-7 Action Item No. 8 - - Use of refuge lands for temporary material placement should be with the coordination and approval of the Service.

(13) Page A-9 Action Item No. 9 - - Berth nourishment should not be a justification for disposal on refuge land.

11. See response to comment 3.

12. The statement has been deleted to avoid implying that the Corps intends to manage the river for fish and wildlife.

13. On the basis of an equipment analysis and the proposed demonstration dredging activities (Further study Item 1), the Corps may modify its dredging fleet and/or contract the work out. The contracts would not specify that contractor must use the most "efficient" equipment, but the contract would be awarded to the contractor bidding the lowest total amount to do the specified work.

- (14) Page A-12 Action Item No. 14 - - - Establishment of sanitary pump-outs and trash pick up would require coordination with the Service if refuge land is involved.
- (15) Page A-13 Action Items Nos. 16 & 17 - - - We feel installation of culverts at lock and dam 4 and 10 needs more study and coordination with the Service and must be consistent with the refuge master plan. O & M funds and manpower are not currently available for the work needed to utilize the water at L & D #10 (Hatchery Ponds). We also feel benefits may be questionable considering the economic cost involved.
- (16) Page A-13 Action Item No. 19 - - - Many historical beach sites are refuge land. Recreational facilities involving refuge lands must be consistent with the refuge master plan.
- (17) Page A-14 Action Item No. 20 - - - Development of lockage waiting areas should be coordinated with the Service and be consistent with the refuge master plan.
- (18) Page A-14 Action Item Nos. 21 & 22 - - - These actions should recognize refuge lands and provide for coordination with the Service at the earliest stage.
- (19) Page A-16 Action Item No. 26 - - - Development of canoe trails must recognize the refuge and be consistent with the refuge master plan.
- (20) Page A-17 Action Item No. 32 - - - The GREAT recommendation does not support trash collection facilities which may encourage additional recreation and intensify associated problems. We would favor the GREAT recommended action.
- (21) Page A-18 Action Item No. 36 - - - Ultimate management authority of the Service for refuge lands must not be subverted. (See FWS letter in GREAT I Exhibit 1.) Per the GREAT Recommendation, any such group should be co-chaired.
- (22) Page A-21 Pol./Fund #1 - - - GREAT recommendation implies unlimited navigational growth which is not supported by the Service (See FWS letter GREAT I Exhibit 1).
- (23) Page A-23 Pol./Fund #7 - - - This recommendation applies to all State and Federal agencies. In this regard, it would appear appropriate for the Corps to attempt to change its authority to correct damage caused by past channel maintenance activities. Also, coordination with the Service concerning management of refuge lands is not mentioned.

14. These projects are considered worthwhile on the bases of information provided by the GREAT team. The Corps will coordinate fully with the Fish and Wildlife Service and appropriate State agencies in developing acceptable plans for implementation. If further evaluation shows that these projects cannot be justified, construction would not proceed.

15. Currently, the wording has been revised.

16. The intent of the "River Maintenance Coordination Forum" is to maintain the coordination and consultation developed during GREAT I. No agency or state authorities would be subverted by the forum.

17. The GREAT I recommendation includes the words "consistent with other resource requirements." These words seem to imply "limited" rather than "unlimited" navigational growth.

18. The Corps does not intend to mitigate damage caused by past channel maintenance activities. The limiting factors on mitigation are generally funds and feasibility. Coordination with the Fish and Wildlife Service will be continued.

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
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(24) Page A-25 Pol./Fund # 1 - - First Priority and Full Program Actions do not recognize that "assist" means with the approval of the Fish and Wildlife Service and representative states.

(25) Page A-28 No. 19 - - The moratorium referenced in the Basic Program has been initiated by our respective agencies. Granting of future permits or licenses for activities on refuge lands must be consistent with our refuge master plan, which is not mentioned in the report.

(26) Page A-29 No. 21 - - Any actions involving refuge lands must be consistent with the refuge master plan.

(27) Page A-29 No. 22 - - Recreation surveys should be coordinated with the Fish and Wildlife Service concerning our responsibilities for refuge lands.

(28) Page A-30 No. 23 - - Corps recreation plans must be consistent with the refuge master plan and the Service's policies and legal mandates.

(29) Page A-33 No. 5 - - The programs mention only the study of dredging requirements. A total environmental evaluation is needed in each case.

(30) Page A-40 No. 28 - - Contrary to the Basic Program, there is no effective coordination with the Service at this time concerning operation of pool levels. We would certainly support the initiation of such coordination.

(31) Page A-41 Nos. 30 & 31 - - On refuge lands, timber management should be primarily for wildlife benefits and under the direction of the Service.

(32) Page A-44 No. 41 - - Development of recreational facilities on refuge lands must be coordinated with the Service and consistent with the refuge master plan.

(33) Page A-46 No. 47 - - Management responsibility of Corps-owned refuge land is not discussed as per the GREAT recommendation. Such management responsibility should be documented and should reflect our responsibilities in this matter.

(34) Page A-47 & 49 - - See comment No. 21.

(35) Page E-32 New Work par. 2 - - The Fish and Wildlife Service has mandated authority for fish and wildlife management on the refuge

19. The GREAT I recommendation does not mention "approval." However, the Corps will fully coordinate all of its activities on the river with the appropriate Federal and State agencies. It is difficult to imagine that any enhancement project that is actively opposed by the Fish and Wildlife Service and the affected State(s) would be implemented.

20. The primary thrust of the GREAT I recommendation is that wing dams and other closing structures should be studied to determine if modifications could reduce dredging requirements or shift them to more desirable areas. The Corps proposed programs are geared toward assuring these questions. If the studies indicate that modifications would achieve the desired goals, the Corps would evaluate in detail the environmental effects of the modifications.

21. The Basic Program description has been modified. The Corps believes improved coordination is highly desirable and that the Corps and other Federal and State agencies must actively promote it.

22. For refuge lands, this may be the case. For Corps lands, the recreation and resource management plan update (specifically the forestry management appendix) will delineate the management practices to be used.

23. The Basic Program has been modified to reflect this comment.



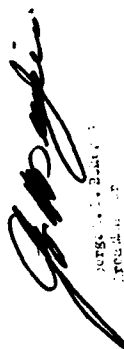
ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

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lands which should supersede Corps discretionary authority for recreation developments. Any recreational development affecting refuge lands must be coordinated with the Service and consistent with our refuge master plan.

We appreciate the opportunity to offer our comments on this important document and look forward to our continued coordination in implementing the GREAT I Study.

Sincerely yours,



JOSEPH M. GILBERT  
DISTRICT ENGINEER

10

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24. The St. Paul District looks forward to a continued good working relationship with the Fish and Wildlife Service as implementation of GREAT I recommendations proceeds in conjunction with operation and maintenance of the 9-foot channel.



DEPARTMENT OF TRANSPORTATION  
UNITED STATES COAST GUARD

(d)

Tel: 314-425-4601  
FTS 279-4601

Colonel William SANDER  
District Engineer  
St. Paul District Corps of Engineers  
1135 U. S. Custom House and Post Office  
St. Paul, MN 55101

Dear Colonel SANDER:

As you are aware, the Department of Transportation (DOT) representative voted to disapprove the final draft of the GREAT I study. Although that document contains many recommendations affecting the environment and transportation which are fully supported by DOT, the Channel Maintenance Plan proposed therein does not appear to take into account numerous considerations vital to the safety of marine commerce.

Enclosure (1) contains a technical explanation of my viewpoint in this matter. I urge you to discuss it with members of the study group in order that they may be made fully aware of my concerns dealing with marine safety. Further, I recommend that implementation of a reduced dredging plan be deferred until a more rigorous examination of this matter is conducted to ascertain the amount of overdredging deemed prudent for safe river transportation. In that regard, I suggest that an independent expert, perhaps a naval architect from an institution such as the University of Michigan be consulted on this matter. Additionally, I am certain that industry would be agreeable to providing a demonstration of some of the phenomena noted herein if that were desired.

If I can be of any further assistance, please do not hesitate to contact me.

Sincerely,

Copy to:  
Colonel Frederick HELLER  
Rock Island Life  
Colonel Robert DUNCAN  
St. Louis Life

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

It is unfortunate that the Coast Guard representative cannot approve the final GREAT I report. The Cgp was intended to ensure the integrity of the 9-foot channel through agreed-upon placement sites for dredged material and other appropriate actions. There does not appear to be any quantitative definition of appropriate overdredging needed to provide a "safe" channel for commercial navigation. Coordination will continue with all agencies through the channel maintenance forum or other appropriate mechanisms to ensure that the Coast Guard's concerns are addressed. On the basis of the GREAT I recommendations for reducing dredging volumes, appropriate safeguards appear to be integrated to provide for "safe" navigation.

Demonstrations of the phenomena listed in your enclosure may be helpful in some cases; however, most of the concern is at specific sites. Reduced-depth dredging has been used at selected sites over the last 6 years with some success. The Corps plans to continue the practice after making sure that appropriate steps are taken to minimize potential adverse effects on commercial navigation. This issue is discussed further in the "Discussion of Major Concerns" section (beginning on page E-5)

1. Definitions - The following definitions were extracted from NAVI SHIPBOARDING by CAPT. R. S. GREENAW, Jr., USN. Although the thrust of the foregoing work is directed toward the handling of naval ships, the principles cited therein are equally applicable to all vessels on all waters:

a. Squatting -

"As a ship increases speed, she sinks appreciably with respect to the mean surface of the water. When her bow and stern rise lower in the water as her velocity is increased and the water level along-side, amidships, is lower than that of the surrounding water. There is a distinct bow wave and a distinct stern wave and the water between the two is depressed. - - - As the ship travels along, she rides in a depression created by her own passage.

If the speed is further increased - - -, the bow begins to rise abruptly and the stern sinks more rapidly - - -. This phenomenon is known as "Squatting" and has a distinct effect on the resistance to the ship's motion and the speed resulting from a given power."

b. Bank Suction -

"As the ship strays from the center of the channel and steams closer to one bank than the other, the passage between her side and the nearer bank becomes even more restricted; the velocity of flow on that side must therefore increase and the water level between the ship and the near bank is lowered. This tends to force the ship into the near bank, and effect known as "Bank Suction". If a ship is maintained on a course parallel to the adjacent bank, she will move bodily into the bank!"

c. Bank Effect -

"As the ship approaches the bank, the bow wave on the near side becomes augmented and tends to push the bow away from the bank - - -. Thus, in addition to the Bank Suction tending to draw the ship bodily into the bank, there is the Bank Effect which applies a twisting movement to the ship and tends to make the ship sheer away from the bank."

2. Effect of Shallow Water -

a. Both sinking and squatting are increased in shallow water, thus further reducing the clearance between the vessel and the channel bottom. The action of the propellers by taking suction from a restricted area causes an increase in sinkage and squatting.

c. More power is required to achieve a given speed through the water as a result of the increase in draft. Thus, at a given speed the wake will be increased over that developed at the same speed in deep water. This creates the possibility for increased bank damage from the resulting ground swell.

d. When the vessel is in shallow water and particularly where irregular shoaling is present, maneuverability will be impaired by an interaction between the hull and the bottom similar to bank suction and the bank effect. In other words, a vessel passing close on either side of a shoal may take a "sheer".

e. If the vessel passes over an isolated shoal area at a speed higher than the critical speed, the lead barge will develop an aggravated sinkage or diving effect and may actually contact the bottom. There are cases where this caused the tow to break up with catastrophic results. It is difficult to predict where all such shoals may exist.

f. In shoal water, the efficiency of the rudders is diminished thus adversely affecting steering or controllability. There is simply insufficient water flowing across both steering and flanking rudders for effective steering.

g. Backing in extreme shallow water results in a loss of seal around the stern causing air flow directly into the propeller. The air flow into the propeller inflow stream causes cavitation and excessive loss of efficiency of the propeller as a propulsive device. This loss of efficiency affects maneuverability (loss of backing power) and has resulted in damage to vessels and marine structures.

3. Effect of a narrow channel - When the cross section of a vessel (or two vessels passing or meeting) is equal to a substantial part of the cross section of a channel, the "sinking" effect is accentuated. The effect of Bank Suction and Bank Effect may be accentuated. Also, vessels passing close aboard experience similar effects resulting from interaction between their hulls.

4. Comment - The foregoing paragraphs describe the effects when operating in shallow water and narrow channels in the general case. Obviously, speed, operating draft, the depth to draft ratio and hull form have an effect.

a. Speed -

It is wise to reduce speed in shallow water if you know, ahead of time, where shoaling has occurred. However, that is often virtually impossible to predict in the rivers when bottom conditions are changing rapidly.

ST. PAUL DISTRICT, COPS OF ENGINEERS  
DISCUSS/RESPONSE TO COMMENTS

2. Draft -

A reduction in berthing draft could ease the problem in special water. Aside from economic considerations, that is not generally feasible in the rivers due to the draft of most towboats.

3. Depth to draft ratio -

According to K. J. Koster in his study PUSH TOWS IN CANALS, "the canal water depth must not be less than - - - 1.5 times the draught of the largest vessel". The foregoing was based upon maneuverability considerations.

4. Hull Form -

No comment is provided inasmuch as a naval architect's opinion would be more appropriate.

5. Recommendation - Review the Channel Maintenance Plan and ascertain whether or not the foregoing items affecting maneuverability and, thus marine safety have been rigorously considered. The potential for collisions and groundings will always exist. However, that potential is substantially increased whenever maneuverability is degraded as would be the case with special water as contemplated. Thus, inadequate design could result in the very impact upon the environment which the GREAT STUDY is attempting to avoid.

1. Refer to discussions of reduced-depth dredging and safety of commercial navigation in the findings on page F-2 and GREAT LCN (beginning on page F-10). These discussions address the concerns you have raised.

DEPARTMENT OF TRANSPORTATION

UNITED STATES COAST GUARD  
Commander (Jcw)  
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Tel. (314) 425-5005  
FTS 279-5005

16004

20 January 1981

Colonel William Badger  
District Engineer  
St. Paul District Corps of Engineers  
1135 U.S. Customs House and Post Office  
St. Paul, MN 55101

Dear Colonel Badger:

Thank you for the opportunity to participate in your 14 January meeting on the GREAT I Implementation Report. We will be providing you with comments on the report in the near future.

A. the Corps has indicated that the district was going to circulate a letter to obtain individual state agency agreement on the definition of an emergency dredging situation. I assumed that approval of GREAT I by the States would automatically change their definition, but perhaps a formal agreement on the subject is in order. The purpose of this letter, however, is to call your attention to the emergency dredging definition adopted by GREAT II. It is the same as GREAT I, but has the added phrase "or when the channel is impassable". The logic behind this addition is to fill the void between the situation when a vessel is, or has, gone aground, and the future condition described as imminent closure. It should make no difference if the channel is closed as the result of a vessel freeing itself, or made impassable due to shoaling from other causes. When the channel is impassable to normal traffic, an emergency does exist.

For the purposes of standardizing the definition for both areas I request that you propose this additional wording from GREAT II in your letter to the states. It was not considered by GREAT I simply because the Team didn't think of it at the time.

R. C. HALTON

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
REPLY/RESPONSE TO COMMENTS

In letters to appropriate agencies involved in permit applications for the 1981 dredging season, the Corps recommended that the GREAT I definition of emergency dredging situations be used on an interim basis. GREAT II includes the condition "when the channel is impassable" in its definition. GREAT I has provided for emergency dredging under the imminent closure definition to allow dredging before the channel becomes impassable. The States have commented on the proposed definition (which the Corps feels is workable); not all agree with the Corps' proposal. Before the 1982 dredging season, the definitions being used in the GREAT I and GREAT II areas should be reviewed for consistency and modified as needed to ensure that the most appropriate definitions are used.



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Colonel William Badger  
District Engineer  
St. Paul District Corps of Engineers  
1135 U. S. Custom House and Post Office  
St. Paul, MN 55101

**Dear Col Badger:**

We have reviewed the St. Paul District Engineers Implementation Report for GREAT I and find it to be a concise document with some valuable data. You are congratulated for producing a quality document in such a short time frame.

One major fault that we do find with the report is that it develops some essential economic data, but continues to assume that all of GREAT's recommendations are desirable from an economic, environmental and operational viewpoint. As noted in our disapproval of the GREAT I Report DOT, does not concur with that assessment. Data contained in the implementation report appears to support DOT's concern that, in addition to safety aspects, the chemical maintenance plan is incomplete and therefore unacceptable. It is incomplete in that:

- It is not flexible enough to meet future conditions and change.
- It is based on faulty assumptions related to site access, site availability, dredging volumes, equipment utilization, beneficial use demands, and environmental benefits.
- It does not include riverine disposal.
- It does not assess the economic impacts to navigation, or contain sufficient economic data to assess the various programs proposed.
- It treats environmental impacts only in generalities and fails to recognize that channel maintenance activities do not eliminate habitats, but only change them from one habitat type to another. An evaluation using habitat units would be more appropriate.

We trust that our concerns will be addressed through a critical review of the report at subsequent administrative levels.

by size and by type of use, to make data for recommendations within the 100-year period. The size and type of land use are used in determining overall land use in the 100-year period. In the First Priority Program, the recommendations of the land use planning study do not appear to be fully and uniformly reflected in the First Priority Program. The size and type of land use are not reflected in the First Priority Program. The QIP does not clearly spell out all the requirements, but it does indicate that the economic and environmental effects of each site, including the recommended sites, do represent sites selected upon the basis of the economic, environmental, and social analysis of each site. It is needed to determine if the merits as required by Federal laws and regulations, the QIP must be flexible and allow for future conditions and changes. Continued coordination through the "barn" maintenance program will ensure that necessary modifications are incorporated into the QIP. It is recommended that the QIP could be modified to accommodate future changes. It further evaluation proves it is desirable, while quantitative measures of the economic, environmental and environmental resources are not available, it is recommended that the QIP be modified to reflect the quantitative measures of the QIP. The QIP is a very important part of the recommendations would be very useful, but the QIP is a very important part of the recommendations.

ST. PAUL DISTRICT, MISSISSIPPI RIVER  
RECOMMENDATIONS TO CONGRESS

4. During the site selection process used by GREAT I, NAB and its sites were identified in addition to the recommended sites. The St. Paul District will evaluate in detail the recommended and other sites before any site is used as part of the long-range plan.
5. Refer to the discussion of reduced depth dredging and safety of commercial navigation (beginning on page 49).
6. The section has been revised to correct the error.

7. The section has been revised to correct the error.

8. The section has been revised to include the rationale provided by the GREAT I Team.

9. The Maritime Administration will be notified of future channel maintenance forum meetings and invited to participate.

10. St. Paul District's experience with the Dredging Survey and dredge Thompson fleets indicates that fuel consumption per cubic yard dredged is about the same. Fuel consumption will be considered if the Government acquires any new equipment.

11. If additional equipment is to be acquired, costs would be compared. Volumes would be considered and mechanical dredging capability whenever the mechanical dredging could not complete the dredging in a timely fashion and costly channel closures might occur. In those cases, if both mechanical dredging would eliminate the problem, the mechanical dredging would be the method of choice.

12. GREAT I projections for future dredging requirements were based on the dredging done from 1950 through 1975. The period from 1975 through 1990 was not used because volumes dredged are not necessarily representative of volumes and locations where dredging would be required. The actual dredging done appears to be reasonably representative. Appendix C discusses the reliability of the data used to estimate dredging volumes. Using a short-term estimate as the last six years could result in errors in projections. It is noted that dredging requirements will differ from the projections because of new variables, such as increased volumes of dredging, increased dredging, and increased dredging. The actual dredging done from 1975 through 1990 was not used because volumes dredged are not necessarily representative of volumes and locations where dredging would be required.

A basic deficiency in the GREAT I report is its environmental bias and the lack of clear alternative plans required by Principles and Standards. It is recommended that the St. Paul District develop a dredging plan with NED objectives and cost projections since Congress should be provided with a choice of plans rather than approval or rejection of the recommended plan.

The following specific comments are offered.

- a. Implementation of the reduced depth dredging should be deferred until the safety concerns raised in Admiral Venzke's letter are properly addressed.
- b. A statement on page 49 regarding purposes of the 9 foot navigation project are incorrect. The GREAT I Team is not proposing that Fish, Wildlife and Recreation become project purposes. The recommendation calls for the Corps to "assist" the USFWS and the States in accomplishing conservation and recreation projects.
- c. Page 49 also contains a discussion of a definition for the navigation project. The actual definition is contained in the rationale which should be included here. A condition for DOT approving this recommendation, with the definition in the rationale, was the teams assurance that the two would not be separated in any GREAT or related documents.
- d. Neither USDOT or the Corps of Engineers represents the maritime industry. It would be most appropriate to include the U.S. Department of Commerce, through the Maritime Administration, as a member of a river resource management body.
- e. The discussion and evaluation of various dredging methods and equipment should include fuel consumption. Our data indicates mechanical dredging will consume roughly five times more fuel than hydraulic dredging.
- f. It is recommended on page 3-36 that "the hydraulic dredge be used in emergency conditions and when volumes are beyond the mechanical dredging capability". That volumes are considered beyond mechanical dredging capability! The proposed policy does not appear to adequately consider the dredging time for each method and its interference with navigation during dredging operations. A systems approach to dredging is logical, however, we do not see a cost comparison between the dredging systems recommended.
- g. GREAT I in their planning process considered all dredge cuts since the 9' navigation project began. This appears to be an unrealistic approach as the river has been continually adjusting to its new cross-section and grade since the navigation project was completed. The result of this adjustment has been less dredging in recent years. The District's analysis of the Channel Maintenance Plan should be based on more recent dredging experience, such as the last six years.



b. Dredging equipment requirements for the Rock Island District have not been addressed in the report. Figure C-2 indicates the dredging season as being five months long, from June to November. The St. Paul District, however, has historically provided dredging equipment to the Rock Island District in September. With or without this additional time requirement, the mechanical dredging units are highly suspect in their ability to perform the required channel maintenance in a timely manner to meet navigation needs.

i. Plate E-5 is misleading since it indicates that a cost savings is realized by reduced depth dredging. It should more appropriately be called "A Reduction in the Additional Cost of Environmental Protection Provided by Reducing Channel Safety and Efficiency." Any discussion of costs related to reduced depth dredging should include costs to the navigation industry.

*R. C. Walton*  
R. C. WALTON  
Captain  
U. S. Coast Guard

Copy: NCD/COE

As shown in Figure 6, the majority of dredging in the St. Paul District has been completed before September, mainly because the dredge Thompson is also used in the Rock Island District. Dredging needs in the Rock Island District must be considered in the overall equipment analysis for implementing the plan, and the RIAI (1) in addition to other constraints on equipment purchasing, use, and availability.

4. Figure 2 can be used to estimate potential savings of reduced dredging volumes at various levels of environmental protection consideration, with purpose is to illustrate the relationship between costs and quantified dredging for various levels of environmental protection. The discussion in this section is intended only to address the costs of dredging and not all other considerations. Refer to the discussion on reduced-depth dredging and safety of commercial navigation (beginning on page 13).

the 100,000 of strict look forward to working with the Coast Guard in a relaxed operation and maintenance of the 9-foot channel and implementation of many of the Great Recommendations.



## Department of Transportation

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION RESPONSE TO COMMENTS

January 12, 1980  
44-0-67,000

Colonel William Badger  
District Engineer  
St. Paul District Corps of Engineers  
1115 "S" Custom House and Post Office  
St. Paul, MN 55101

Dear Colonel Badger:

We have reviewed the "Draft Implementation Report for the GREAT I Study, November 1980" and comment as follows:

The report presents three alternative programs for implementation of the GREAT I recommendations, including the GREAT I Channel Maintenance Plan.

1. Basic Program--Continuation of operation and maintenance of the nine-foot Navigation Project and to comply and incorporate as many of the GREAT I recommendations as current funding levels and scheduling will allow.
2. First Priority Program--Implementation of the higher priority GREAT I recommendations contingent upon justification and receiving necessary funding increases. This would increase annual operation and maintenance costs by about \$1 million.
3. Early Implementation of GREAT I Program (GREAT II)--Full implementation of all GREAT I recommendations. This would increase annual operation and maintenance costs by about \$9 million.

The draft report recommends that the "First Priority Program" be implemented. After careful review of the subject report the Iowa Department of Transportation finds a lack of justification for the above recommendation. Although many of the GREAT I recommendations were supportable, we found the Channel Maintenance Plan to be unjustified and unacceptable. The US Coast Guard also opposes the GREAT I Channel Maintenance Plan (see attached letter from US Coast Guard to Colonel William Badger). The Coast Guard particularly objects to the proposed reduced depth dredging program, when considering the economic importance of commercial navigation to Iowa and the remaining Midwest, we cannot support a channel maintenance plan that does not meet the minimum safety requirements of navigation. Also, page D-29 of the subject report states "Thus, implementation of methods to reduce depths of dredging will have adverse economic impacts upon the commercial transportation industry."

1. The reference to the CDP not meeting the minimum safety requirements of navigation appears to overstate potential adverse economic impacts on commercial transportation. Reduced-depth dredging has potential adverse impacts; however, the 6-year trial period during GREAT I does not evidence any significant effects. As described in the GREAT I documents, decisions regarding dredging depths would be made on a case-by-case basis, considering fully potential adverse impacts on commercial navigation and trying to minimize those impacts. Refer to the discussions beginning on page 1-3.

Colonel Radger  
Page Two  
January 12, 1981

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
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Historically, dredging in the GREAT 1 area has been primarily accomplished by a hydraulic dredge with placement sites located on federally-owned land within one mile from the dredge site. The GREAT 1 Channel Maintenance Plan proposes that most dredging would be accomplished by mechanical dredges and the material barked to placement sites on private land located out of the floodplain.

Costs associated with the continued maintenance of all modes of transportation have been rising rapidly in recent years. Future monies available for maintenance of transportation systems will need to be spent wisely to meet the needs of commerce. Implementation of the GREAT 1 Channel Maintenance Plan would have an adverse cost impact on transportation, while showing little positive benefit to fish and wildlife or recreational interests. Page 8-22 of the subject report states "implementation of the Channel Maintenance Plan will generally have the effect of reducing the amount of dredged material which would be available for maintaining or enhancing existing or new placement area sites for river recreation uses." Thousands of vacationers visit the river each year and use the recreational beaches established by dredged material. The periodic placement of material on existing recreation beaches is important for controlling vegetation growth.

Beneficial use of dredged material was a major criteria for disposal site selection, but sand is cheap and plentiful in the area and therefore, no real beneficial uses have been identified. In choosing these disposal sites, the GREAT Team overlooked or voted down many closer and more cost-effective sites. But dredged material is placed on less than one percent of the federally-owned land. Such placement does not destroy, but merely alters the land from an environmental standpoint. These tradeoffs are reasonable and necessary because of the multi-purpose nature of the navigation project.

The cost and uncertainties in acquiring private lands for disposal sites are difficult to justify. Page 8-4 of the subject report states "The GREAT Channel Maintenance Plan disposal sites were selected with little consideration or investigation into the availability of the site." The report goes on to point out that if land owner opposition to material placement is encountered, direct acquisition will be necessary.

Equipment capability is extremely important when choosing dredging equipment. We do not believe the capability of mechanical dredging is sufficient to meet channel maintenance needs in a timely manner. Page 8-6 of the subject report states "The primary disadvantage of conventional mechanical dredging is relatively low production rates." The report identifies a medium-size hydraulic backhoe as best suited for mechanical dredging in the GREAT 1 area. However, page 8-11 shows the capacity for this type of dredge to be only 81,000 cubic yards/month. This would allow only one or two dredge cuts to be made per month with this piece of equipment. We realize that a large hydraulic dredge will be retained in the district for emergency dredging operations. However, it is obvious that a program geared toward mechanical dredging could have major adverse impacts on commercial navigation. Also,

2. You do not feel the CMP is justified because the major benefits and justification are in the category of unquantifiable environmental benefits and compliance with environmental laws. However, the judgment as to whether the actions are justified is related more to the relative worth of the environmental habitat.

3. Although implementation of the CMP would reduce material available for beach nourishment, implementation of Action Item 19 would compensate through positive action to maintain desirable beaches. However, the St. Paul District shares your concern.

4. Although the potential for beneficial use of dredged material does exist along the river, a major factor in assessment of the potential is the cost of providing material to a user. Dredged material does alter land use, and, from a biological productivity standpoint, converting a very productive wetland to a relatively sterile upland habitat represents a dramatic loss of biological productivity at that site. The reasonableness and need for this type of trade-off is certainly a subjective judgment.

5. Refer to discussion on acquisition of private lands beginning on page 8-9.

6. The proposed dredging fleet (two mechanical units and one large hydraulic unit) would have similar or even greater response capability than the district fleet. Indirect effects of dredging are greatest in the floodplain area.

Colonel Badger  
Page Three  
January 12, 1981

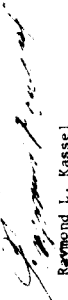
ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

this report fails to address the environmental impacts of mechanical dredging which inherently represents a more turbid operation than hydraulic dredging. ] b

In view of the above we cannot support implementation of the GREAT I Channel Maintenance Plan. We believe that most of the problems which brought about the need for GREAT have already been solved through the interdisciplinary management approach. The Corps should continue to employ this approach with the ongoing Channel Maintenance Program. The "River Maintenance Coordination Forum," presently being organized, should participate in the evaluation and selection of future dredged material disposal sites. However, the Forum must not be bound to selection of sites identified in the GREAT I Channel Maintenance Plan. ] x

Thank you for the opportunity to comment on this report.

Very truly yours,

  
Raymond L. Kassel  
Director

RLK:JR:ss  
cc: Dr. Samuel Tuthill

6. The turbidity caused by dredging is usually a minor consideration.

7. Refer to discussion of the CMP beginning on page F-1..

8. The St. Paul District looks forward to working with the Iowa Department of Transportation in its operation and maintenance of the 9-foot channel and implementation of many of the GREAT I recommendations.

AN EQUAL OPPORTUNITY AGENCY

January 23, 1981

Colonel William M. Badger  
District Engineer  
St. Paul District Corps of Engineers  
1135 U.S. Post Office and Courthouse  
St. Paul, Minnesota 55101

**Dear Colonel Badger:**

The Iowa Conservation Commission has reviewed the "Implementation Report for the GREAT 1 Study". Your efforts and those of your staff are to be commended for the manner in which the report addresses the complex issues centering on the Upper Mississippi River as defined in the GREAT study reports.

We endorse the "First Priority Program" as outlined in your report. It appears to us to represent a proper mix of action and study. Coupled with an effective, on-going communication/coordination effort such as that potentially available through the "River Maintenance Coordination Forum", the First Priority Program offers real hope for achieving a significant portion of the river system management strategy originally spelled out as a goal of GREAT.

We share some of the concerns expressed during your January 14, 1981 meeting in St. Paul relative to benefits to fish and wildlife and recreation as portrayed in Table 7, page 14. Many of the Corps-related and GREAT I recommendations are aimed directly at increased protection and improved management of fish and wildlife resources on the Upper Mississippi River. Many others are aimed at increasing and improving the quality of other recreational opportunities.

While such benefits may be difficult to quantify in a table such as Table 1, it is important to at least narratively address them in the table. Table 1 describes that table. These benefits were and still are the major goals of improved river management and would be partially realized through implementation of GREAT recommendations.

In line with Governor Ray's letter of October 29, 1986, we feel it is also important to note that local's perception of the channel maintenance plan for this document must be a moderately flexible guide which provides a reasonable level of protection for the environment. We interpret this to mean that disposal sites as developed during the WQIAL planning procedure will serve as the basis for future decisions. We will, through

1. The fish and wildlife and recreation benefits section of the main report has been revised. Additional information and discussion of these benefits have been added to Appendix E.
2. The Mc. Paul District views the placement sites recommended in the QDP as a starting point for further detailed evaluations of specific sites. To be implementable, the QDP must be moderately flexible and allow modifications. See discussion of the QDP beginning on page 11.

the 404(c) process, the River Maintenance Coordination Forum and other communications, both in state and interagency, strive to be an active, responsible participant in any future decisions which select different disposal sites or which otherwise impact on the river, its resources and management, and its users.

We appreciate the opportunity to review the Implementation Report.

A representative of the Conservation Commission will be in attendance at the February 5, 1981 Forum meeting as the Iowa spokesman. Quite possibly the Iowa Department of Transportation will also send a representative of their agency. We have encouraged their attendance inasmuch as our two agencies are directly concerned with the river and its use and must be informed on all sides of the many issues in order to develop appropriate Iowa positions.

Sincerely,

LARRY J. WILSON, DIRECTOR  
IOWA CONSERVATION COMMISSION

LJW/cje

cc: Raymond Kassel  
Sam Tuthill

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

3. The St. Paul District looks forward to working with the Iowa Conservation Commission in the operation and maintenance of the 9-foot channel and implementation of many of the GREAT 1 recommendations.



Department of Transportation  
Engineering and Construction  
1115 U.S. Custom House and Post Office  
St. Paul, Minnesota 55101

January 29, 1981

Colonel William Haggner  
District Engineer  
St. Paul District Corps of Engineers  
1135 U.S. Custom House and Post Office  
St. Paul, Minnesota 55101

Dear Colonel Haggner:

Thank you for the opportunity to review the "Rate Implementation Report for the GREAT Study", prepared by your office. We have some concerns about the content and recommendations.

The report recommends implementation of the higher priority GREAT recommendations. As you know, the Minnesota Department of Transportation (MDOT) and other concerned state agencies, through a letter from Governor Quie, recommended that the GREAT Main Report be forwarded to Congress. This recommendation also said that the Channel Maintenance Plan (CMP) must be given further consideration and could only be supported after additional coordinated efforts by the various state and federal participants had modified some of the recommendations. Acceptance of the draft report's first priority program implies acceptance of the Channel Maintenance Plan as it was written. This is not acceptable to MDOT.

Our primary concern is that the CMP recommendations for reduced dredging will eliminate the guarantee of safety for commercial and recreational vessels in the navigation channel. This concern is supported by the U.S. Coast Guard in their letter of November 11, 1980, and the Iowa Department of Transportation in their letter to you of January 12, 1981.

In addition to the loss of safety with reduced depths of dredging, we are concerned with the economic impact on commercial navigation. Studies by the University of Michigan, quoted in the Commercial Transportation Work Group Appendix to GREAT I, demonstrate the effect of various channel depths and widths on vessel speed and fuel use. This is further supported by Page D-21 of your report which says "Thus, implementation of methods to reduce depths of dredging could have adverse impacts upon the commercial transportation industry."

The GREAT Study is a complex project which has involved many agencies and individuals. It is a study of the navigation channel in the St. Paul District of the Corps of Engineers. The study is a result of a long-term effort to improve the navigation channel and to ensure the safety of commercial and recreational vessels. The study is a result of a long-term effort to improve the navigation channel and to ensure the safety of commercial and recreational vessels.

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Colonel William Badger  
January 28, 1981  
Page two

Our second area of concern is the lack of complete economic consideration in the OMP. For example, there is no comparison of the costs of transporting dredged material to a single disposal site for each pool and the historic program of multiple sites or the operating and fuel use characteristics of mechanical and hydraulic dredging.

We feel that the development of a forum for the consideration of continued river maintenance matters could well meet the need for continued coordinated agency efforts to modify the OMP. However, the forum will not be effective unless all concerned agencies are represented. Without the participation of the agencies concerned with commercial navigation as well as those involved in environmental matters, the products of the forum could well have the same problems as are in the OMP.

Our representative to GREAT I has been Mr. M. William Newstrand, Manager of Ports, Waterways, and Pipeline Planning. I suggest that he be included in the forum as the Mn/DOT representative. He can be reached at (612)296-1609.

Thank you for your consideration of our concerns.

Sincerely,



Richard P. Braun  
Commissioner

ST. PAUL DISTRICT, COMPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

4. The additional detailed evaluations planned before implementation of the OMP will address most concerns over selection of placement sites, the selection of mechanical or hydraulic dredges required, full consideration of their operating characteristics. In most cases, fuel consumption is reflected in the costs of dredging and the quantity of fuel consumed per unit production has not varied significantly between St. Paul District hydraulic and mechanical units. If fuel consumption becomes a defining factor, it could become part of the decision-making process to use the consumption is related to the material transport distance.

5. Mr. Newstrand has been contacted and has been invited to the GREAT I forum. The forum has representatives from all concerned Federal and State Agencies, including those concerned with commercial navigation. The St. Paul District looks forward to working with Mr. Newstrand and other representatives of the Department to ensure that the forum's recommendations consider the diverse interests concerned with the Mississippi River.





Minnesota Pollution Control Agency

FEB 25 1981

Colonel William W. Badger  
St. Paul District, U.S. Army Corps of Engineers  
1135 U.S. Post Office & Custom House  
St. Paul, Minnesota 55101

Re: Draft Implementation Report for the Great River  
Environmental Action Team (GREAT I) Study

Dear Colonel Badger:

This letter transmits the comments of the Minnesota Pollution Control Agency staff regarding the referenced document. We appreciate the efforts the Corps has made toward implementation of the GREAT program and we hope our comments will be helpful to you in your considerations of the final Implementation report.

If you have any questions, please contact Mr. Louis Flynn of my staff at (612) 296-7225.

Sincerely,

*Louis J. Breimhurst*

Louis J. Breimhurst  
Executive Director  
Minnesota Pollution Control Agency

LJB/LLF:jae

Attachment

Enclosed is a draft Implementation Report for the Great River Environmental Action Team (GREAT I) Study. The report was prepared by the Minnesota Pollution Control Agency staff and is being submitted to you for your review and comment. The report contains information on the current status of the GREAT program and the proposed implementation plan. It also includes a list of recommendations for the Corps to consider in its implementation of the GREAT program. The report is being submitted to you as a courtesy and to provide you with the information you need to make a decision on whether to implement the GREAT program. The report is being submitted to you as a courtesy and to provide you with the information you need to make a decision on whether to implement the GREAT program.

MINNESOTA POLLUTION CONTROL AGENCY  
Staff

Comments on the Draft Implementation Report  
for the GREAT I Study  
Nine Foot Channel Project  
Upper Mississippi River Area  
(head of Navigation to Guttenburg, Iowa)  
(hereinafter the Report)

St. Paul District  
U.S. Army Corps of Engineers  
November, 1980

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

General Comments

1. The Minnesota Pollution Control Agency (MPCA) generally supports the St. Paul District of the U.S. Army Corps of Engineers (Corps) in their efforts to implement the Great River Environmental Action Team (GREAT) study. We are aware that without Corps efforts and cooperation, many of the findings and recommendations of GREAT could not be implemented and that the commitment of manpower and other resources of the Corps was a major factor enabling the GREAT study to come to completion. We also feel that the Corps will be an essential factor and leading force in turning the study into reality.

2. While we have some concerns regarding the report, it is our impression that the St. Paul District of the Corps intends to actively pursue the implementation of the GREAT Programs. We hope that this spirit will be sustained throughout the Corps review and implementation process.
3. Our major concern about the implementation report is that it does not contain sufficient detail to indicate the exact nature or manner of implementation. It is evident that the GREAT Report, and therefore this report, will be subject to various interpretations and modifications as they proceed through the administrative and legislative processes necessary for implementation. The Corps will play a large role in the implementation of the GREAT program but questions and/or

1. The St. Paul District intends to implement as many of the GREAT I recommendations as possible. Where confusion or controversy arises or concerns are raised, the coordination forum will help in reaching mutually satisfactory resolutions.
2. The objective of the Implementation Report is to outline the direction the St. Paul District plans to follow in implementing the GREAT I recommendations. Additional detail must be developed on most, if not all, of the recommendations before they can be implemented. As this detail is developed, it will be coordinated with all concerned agencies and interests. Specific features of the recommendations may change as additional information is obtained.

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

position have already been raised regarding certain recommendations. To date, no suitable responses to those questions have been made. This leaves the future of the GREAT Program and the Corps implementation of that program uncertain. While we realize that a strong Corps position would not insure that the GREAT Programs would be implemented as intended, a more specific Corps position would give greatly needed direction to the process.

Specific Comments and Recommendations

Action Item No. 1

The Corps of Engineers should implement the dredged material placement plan proposed by GREAT 1.

As of this date, the Minnesota Pollution Control Agency has not been able to review the final version of the Channel Maintenance plan. We expect that we will generally be able to support the plan, but as you are aware, objections to the plan have already been raised by State and Federal Agencies. While we support the general concept of the program outlined by the Corps, we cannot assure that specific approvals would be granted when programs requiring variances from State Rules are proposed.

Action Item No. 4

Average annual dredging quantities should be minimized through application

This recommendation is the subject of some controversy which we feel has

1. Refer to the discussion of the QMP beginning on page F-14.

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

of technically supported reduced-depth dredging and maintenance of minimum channels widths suitable for navigation consistent with the following guidelines:

- a. Dredging depths in approaches to rigid structures should be determined by technically supported safety criteria.
- b. Dredging depths at other locations should be determined based on potential for increase in frequency of dredging, impacts on the transportation industry, and the demand for dredged material in the area.
- c. A literature search and necessary supplemental research should be conducted to document the impact of channel depth on required channel width to maintain navigational safety.

been caused because the GREAT team and Corps have not explained the proposal in sufficient detail. Our discussions with the Corps would indicate that the reduced depth dredging program noted here has been in effect since the beginning of GREAT and that there are no technically supported criteria for the Mississippi River which provide better information than the observable result of this program. Yet, a member agency of the GREAT has recommended that the implementation of the program be deferred, as if this was a new and highly speculative recommendation. Since it would be highly inappropriate to recommend deferral of a program which has been in effect for six years, it would appear that the Corps and other agency members of GREAT have different opinions of what this recommendation proposes.

We would also like to know what safety criteria the Corps intends to use at approaches to rigid structures. It certainly cannot involve the criteria

4. Refer to the discussion of reduced-depth dredging and safety of commercial navigation beginning on page F-5

5. The St. Paul District plans to use the 13-foot depth guideline at approaches to rigid structures. Variations from this policy will be considered in a case-by-case basis through the coordination forum and in permit applications when required.

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

presented by the Coast Guard since this amounts to a series of elementary considerations taken from a course or text in fluid mechanics. The only criteria presented by the Coast Guard is the quote from the Koster study regarding canal depths of 1.5 times the draught. For a nine foot draught vessel this would require a 13.5 foot channel which is deeper than the basic 13 foot depth which the Corps has stated will be and has been the basis of all depth determinations.

The recommendation regarding literature search seems to have been thrown in to satisfy the need that all studies seem to have for recommending further study. In light of the Corps spoken position that this program has been in effect for about six years, this study seems unjustified. On the other hand, if the GREAT intend some new program, this should be further explained so that the study can apply itself directly to the new program.

6. The literature search and analysis of depth and width relationship needed to maintain navigational safety would help satisfy some of the concerns raised about specific sites. This effort would supplement actual practices on the river.

Action Item No. 5

The Corps of Engineers should request the necessary appropriations to purchase efficient dredging equipment to best accomplish all the objectives of the GREAT I Channel Maintenance Plan. Until this equipment is available the Corps should emphasize contract dredging to meet those objectives.

The Corps estimate of the need for one additional mechanical dredging unit should be adequately supported prior to its implementation. While we support the effort of the Corps, we have not been able to review the final version of the Channel maintenance plan and therefore we cannot be certain that the Corps decision is soundly based. In any situation where a variance from State Policy would be proposed, site specific alternatives would be considered. While we generally support the concepts of new mechanical equipment, we must request that more specific information be provided to support your conclusions.

Action Item No. 9

Criteria for sediment and water quality as the 1a to dredging and material placement should be developed by the Environmental Protection Agency in consultation with the appropriate State and Federal agencies. Using these criteria, the States should develop uniform requ-

We feel that the lack of commitment to monitoring of open water disposal of dredged material is an oversight. If we are incorrect, we request that the Corps reconsider this matter. No methods have been determined by any agency, including the Corps of Engineers

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

7. Equipment needs will be analyzed as part of the more detailed evaluation of the CMP. This analysis will be completed before any major investment in a new Corps dredging fleet. Additional coordination is needed with State and Federal regulatory agencies to reach agreement on suitable effluent standards for uncontaminated material because these standards will affect equipment requirements.

8. The exclusion of monitoring of open water placement from the draft report was an oversight. Monitoring has been included in the final report.

lations for the control of dredging and dredged material placement.

In the interim, the following guidelines should be used to determine proper methods for dredged material placement.

a. An adequate bottom sediment data base at frequently dredged locations should be developed and maintained.

b. It should be determined if the material to be dredged is contaminated using 40 CFR 230, Interim Guidance for Section 404(b) of

Public Law 92-500, Implementation Manual for Section 103 of Public Law 92-532, EPA's "Working Guidelines for Sediment Classification" (Great Lakes Criteria), and any other appropriate information in coordination with the affected States and agencies.

c. Contaminated dredged material shall be placed in an environmentally safe containment area.

d. Uncontaminated material shall be placed in accordance with the GREAT 1 channel maintenance plan. If the channel main-

tenance plan is not developed, the Waterway Experiments Station, that are predictive of water quality impacts. Also information listed in part b. was not presented as being 100 effective in determining the existence or nature of pollutants. The Water Quality work group of GREAT has noted the concern for potentially bioaccumulative elements and other potential effects of dredging and disposal. We feel that open water disposal of dredged material should be monitored until the recommended criteria are developed.

nance plan site cannot be used, an alternative site shall be selected in coordination with the affected States and agencies including using the *On-site Inspection Team process*.

Open-water placement or beach nourishment may be considered as an alternative.

e. Water quality during dredging and placement should be monitored whenever dredged material or supernatant is returned to the water. Treated effluents shall be monitored for total suspended solids, turbidity, and other appropriate parameters of concern. Open-water placement shall be monitored emphasizing the use of indicator parameters, water quality standard parameters, and toxic substance scans. Water quality and sediment monitoring programs should be coordinated among affected States and Agencies.

Action Item No. 11

Bank stabilization and establishment of sediment traps or low-head dams near the mouth have been identified as potential alternatives for sediment control on the Chippewa River and should be further

We request copies of the mathematical and physical model reports on the Chippewa River.

9



evaluated and implemented as soon as possible.

Action Item No. 14

Sanitary pump-outs and trash pickup should be established in suitable areas.

We support the program of the early implementation of first priority.

Action Item No. 36

Recommendation

The agencies represented in GREAT I, by letter of agreement, should continue to coordinate implementation of the channel maintenance plan and all other implementable recommendations through the continuation of an ongoing interagency management coordination team. The U.S. Fish and Wildlife Service and the Corps of Engineers would be the initial co-chairs. Chairmanship would then be rotated among participating agencies. Participation in this activity will be staffed and funded by individual agency contributions. Agencies will request additional appropriations within existing programs where necessary to accomplish this effort.

The "River Maintenance Coordination Forum" or some alternative group in necessary if we are to implement this GREAT program in a coordinated manner. As evidenced in our meeting of January 14, 1981, there are many unresolved questions regarding the structure and functions of this organization. The forum would provide a mechanism between the Corps and the State of Minnesota. We would support the idea of a forum to exchange information regarding river maintenance and related activities.

Action Item No. 37

Recommendation

As part of the above activity/organization the following coordination mechanisms should be used:

a. The Interagency On-Site Inspection Team recommended by GREAT 1 should be continued to provide consultation in the site-specific implementation of the channel maintenance plan and to aid in resolution of new problems which may develop during the annual dredging seasons. Exhibit 1 shows guidelines for continuation of the onsite inspection team.

b. A channel dimension review committee should be established, consisting of representatives of the Corps of Engineers, U.S. Coast Guard, and navigation industry, and representatives from other concerned State and Federal agencies that have expertise in hydraulics or vessel navigation requirements. The task of the committee will be to review industry needs for channel

widths and advise the Corps of Engineers in establishing acceptable channel widths and thus quiding dredging operations at affected sites.

c. The existing independent Upper Mississippi River Conservation Committee is encouraged to participate in the on-going interagency management coordination team. It is suggested they evaluate their role in this effort and participate in a manner they feel appropriate.

POLICY/FUNDING NO. 3:

Emergency dredging should be defined as dredging required to free a grounded vessel or remove shoals in the channel as a result of a vessel freeing itself. The emergency will continue only until an adequate channel depth and width, as determined by the Corps of Engineers, is restored to allow vessel passage.

Imminent closure should be defined as:  
a. The actual water depth is projected by the District Engineer to be 10 feet or less within 14 days or less.

This recommendation and its implications have not been adequately discussed by GREAT. This leaves the purpose of the recommendation to be interpreted by the Corps, and other implementing agencies. We intend to work with the Corps during the permit process or by other methods to develop a program dealing with emergencies and imminent closure.

10

10. The GREAT I and GREAT II definitions pertaining to emergency dredging differ. The St. Paul District is willing to use the GREAT I definitions for the 1981 dredging season, but agrees that additional work is needed on the definitions. Refer to the Coast Guard's comments and our responses on page F-19.

b. The channel width is less than 85 percent of the normal.

POLICY/FUNDING ITEM 8

Recommendation

Congress should define the Mississippi River 9-foot navigation project as that necessary to afford safe navigation for vessels with a draft no greater than 9 feet.

While we tend to agree with the Corps position in this matter, it should be noted in our comment to Action Item No. 4, the intention of the GREAT regarding specifics recommendations can be divergent even between agencies of the GREAT itself. While the Corps indicates that additional definition by Congress is not necessary, GREAT continues to recommend this change.

The MPCA has previously written the Corps regarding this recommendation, but to date we do not feel that a satisfactory response to our inquiry has been received. Certainly the GREAT does not offer anything which would help clarify the intention of this resolution. Despite numerous comments to the draft documents regarding the accuracy of the quotations and applicability of comments no corrections to the final text were made.

11. Clearly, the interpretation of this recommendation gives rise to problems. A more precise statement of what is meant by "safe navigation" is needed before this definition would help in resolving the issue. Also, refer to the discussion of reduced-depth dredging and safety of commercial navigation beginning on page E-3.

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
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(The definitive comments on this subject seem to have been offered by the Sierra Club, interested parties should obtain and review those comments.)

Since great has left no documentation of its intentions regarding the recommendation, the interpretation of the recommendation is left to the implementing agencies. Some groups seem to be advocating a 13.5 foot channel, while other groups seem to be advocating business as usual, and yet others continue to await the results of litigation on previous issues presently before the Federal Courts. Each side seems to have founded its position on the GREAT program. We therefore feel that the interpretation of the recommendation is an important issue which should be resolved as soon as possible.

11

FOR THE ST. PAUL DISTRICT

A demonstration dredging project should be conducted during 1980 or 1981 by the St. Paul and Rock Island Districts of the Corps of Engineers to determine the feasibility and cost effectiveness of

We support the concept of testing the equipment and methods available to the Corps, but the tests should be related to the implementation of the Channel Maintenance Plan.

12

12. The St. Paul District agrees. Equipment tests would be conducted where they relate to implementation of the CDP or proposed modifications to the CDP.

accomplishing channel maintenance by the following methods:

- 1) Mechanical dredging with a backhoe directly loading onto barges.
- 2) Hydraulic dredging with direct loading onto barges.
- 3) Mechanical unloading at placement sites.
- 4) Hydraulic unloading at placement sites.

FURTHER STUDY NO. 11

While we have not reviewed the final Channel maintenance plan, we question whether there is any basis for a study of riverine placement in the Channel maintenance plan. While we support studies of alternative methods, our approval of a test involving a variance from State rules would be based on a site specific evaluation of benefits, and consideration of alternatives. Only where it can be shown that the potential benefits will outweigh the negative impacts should the project be considered.

While we have not reviewed the final Channel maintenance plan, we question whether there is any basis for a study of riverine placement in the Channel maintenance plan. While we support studies of alternative methods, our approval of a test involving a variance from State rules would be based on a site specific evaluation of benefits, and consideration of alternatives. Only where it can be shown that the potential benefits will outweigh the negative impacts should the project be considered.

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13. The results of riverine placement tests to be conducted in the Rock Island District (GREAT II) will be examined and the applicability to the St. Paul District (GREAT I) will be considered. Preliminary indications are that the potential for favorable results is high. If riverine placement proves successful, modifications to the CDP would be considered to allow riverine placement at appropriate locations.



STATE OF MINNESOTA  
DEPARTMENT OF NATURAL RESOURCES

2000 Silver Creek Road N.E.  
Rochester, Minnesota 55901  
(507) 285-7420  
March 2, 1981

Mr. William Spychalla  
Public Information Officer  
Corps of Engineers, St. Paul District  
1135 U. S. Post Office & Custom House  
St. Paul, MN 55101

Dear Mr. Spychalla:

RE: D.E.'s Implementation Report on GREAT I

With the completion of the GREAT I study, those agencies with administrative, regulatory, maintenance, or management responsibilities along the Mississippi must now focus on those issues within the GREAT Report that should receive a high priority for implementation. It is with an eye toward establishing priorities within the Action Items that we submit the following comments:

Action item 1:

It appears that the Corps does not recognize the 1st priority package as essential to a continued channel maintenance program. The tone of the proposal is that the 1st priority package is not essential but would be implemented if other agencies aggressively sought and received necessary funds. We believe the Corps should seek these funds as the minimum level for continued channel maintenance.

The chart on page 34 does not give credit to the benefits accrued to the 1st priority package for commercial as well as recreational activities. The chart is very misleading in that it suggests no net increase in benefits for the 1st priority package. The B-C ratios in the chart for the 1st priority column should be left blank to prevent an invalid comparison with the Basic Program. This problem is aggravated by the obfuscatory explanations in the footnotes associated with the chart. Readers who do not understand the qualifications presented in the footnotes will simply use the chart to compare benefit-cost ratios and arrive at the erroneous conclusion that the Basic Program is the most cost efficient.

Finally, an important fact is the Corps's acknowledgment that the recreational resource is deteriorating significantly under the Basic Program (Footnote 8, p. 34). Therefore, the 1st priority program is the minimum level of channel maintenance for the continued existence of the river's natural resource base.

Discussion of specific maintenance and disposal sites will be submitted at a later date.

Action item 2:

Corps is again adopting a passive approach toward implementation of a

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
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1. The First Priority Program is essential to continued operation and maintenance of the 9-foot channel in a manner consistent with the multiple resource considerations of the GREAT I recommendations. However, Congress must appropriate the funds needed to implement this program. Support from other agencies and the States should help to obtain the required funds. Funds required for the 9-foot channel are in direct competition with funds for other projects nationwide and allocation of funds from the national perspective cannot be made at the St. Paul District level. That decision must be made at the national level. The St. Paul District places high priority on the elements of the First Priority Program and will request funds to implement this program.
2. The chart has been revised. Additional discussion is provided in Appendix E.
3. The footnote referred to stated that implementation of the First Priority or GREAT I program would show degradation of the recreational resource, but the change was not quantified, nor is it quantifiable at this time. The magnitude of any changes with or without implementation of various recommendations is unknown and debatable. Addressing sedimentation and erosion as discussed under Action Item 12 is certainly a key element in any plan to prolong the quality and life of the natural resources of the river.

William Soychalla  
March 2, 1981  
Page 2

maintenance effort beyond the existing operation. The 1st priority package is based on some external source of support for additional funding while not acknowledging the responsibility for aggressively seeking the necessary funds.

The 1st priority package should be supported. It is obvious to us that shoreline protection has been a neglected item over the years and should be reinstituted as quickly as possible.

Action item 4:

We support the 1st priority program. This proposal could prove very cost efficient and provide a technical basis for identifying areas of reduced depth dredging.

Action item 5:

A comparison of the work elements in the three program levels under this action item seem strikingly similar. The Basic Program reflects what has been done in past years, the 1st priority program resembles preliminary plans for the 1981 dredging program and the Early Implementation proposal does not seek any of the techniques such as the 9 yard backhoe recommended in the GREAT Report.

Generally, the three program levels seem disappointingly conservative and written to justify the continued use of the existing equipment and techniques rather than to seek innovative resolution to the dredging problem.

Action item 6:

Quite honestly, most of our concerns would be accommodated at the Basic Program level.

Action item 7:

We support the 1st priority program. As the D.E.'s report suggests, the search for potential users for dredged material should be an ongoing program.

Action item 8:

The active pursuit of the mechanical handling equipment cited in Action item 5 would facilitate the use of temporary disposal sites.

Action item 9: No comment

Action item 10:

This issue is not a priority in comparison to dredged spoil disposal problems. To the extent that this item competes financially with other issues, it should be acknowledged as a low priority project.

Action item 11:

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
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4. The First Priority Program for this recommendation has been revised to place more appropriate emphasis on the equipment analysis to be conducted. However, according to the preliminary information as presented in Appendix B, the 9-yard backhoe is not as efficient and practical as the GREAT 1 report indicated. The equipment analysis will include appropriate demonstration dredging (Further Study Item 1).

5. Each recommendation has been given a relative priority to assist in the allocation of funds. Even though this recommendation is given high priority, it would be considered somewhat lower than some other aspects of the GEP.



ST. PAUL DISTRICT, CORPS OF ENGINEERS  
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page 3

We support the 1st priority level, but must voice some concern for the environmental effects of the low head dam proposal. Along with an aggressive program to acquire new dredged spoil handling equipment, we view control of sediment at this site as among the highest priorities listed in the Action Items.

Action item 12 - 39:

Any Corps of Engineers commitment to implementation of these items should not be at the expense of Action Items 1 thru 5 and 11.

Other Comments:

Policy/Funding Item 6 - It has been obvious since the inception of GREAT that private land acquisition for dredged spoil disposal is necessary. Since the Corps has the internal authority for land acquisition without Congressional action, it is surprising that the district has not already resolved this issue.

We must express our disappointment that the Corps is still discussing the need for a land acquisition policy when in fact, our agency assumed you were already negotiating for specific properties.

The urgency of the Read's Landing disposal problem stands in stark contrast to the Corp's passive approach toward implementation of a land acquisition program.

Finally, it is unfortunate that the D.E.'s report was not used as a means to focus on those major environmental issues that the Corps could most effectively address; such as disposal site acquisition, equipment acquisition, disposal site development, and sediment source analysis.

We realize, however, that the scope of GREAT rapidly diversified into areas which were not central to the channel maintenance program nor within the traditional Corps of Engineers mission. During the implementation phase, it will be those problems most closely related to channel maintenance and dredge spoil disposal that will receive our closest attention.

Thank you for the opportunity to comment.

Sincerely yours,

*John R. Chell*  
John R. Chell  
Regional Administrator

cc: Jim Schneider  
Bruce Hawkins  
Jerry Kuehn  
Don Buckhout  
Glenn Warner

6. The St. Paul District is pursuing acquisition of easements at placement site 4,24. However, acquisition must be approved at the Division level. The Corps' general policy is to minimize land acquisition, and justification must be provided for deviation from this policy. Approvals are anticipated on a site-specific basis when justified.

7. The St. Paul District looks forward to working with the Department of Natural Resources as it proceeds with operation and maintenance of the 9-foot channel and implementation of many of the GREAT I recommendations. In many cases, more detailed justification will be provided in annual budget submissions and other supplemental reports. These reports will be coordinated with interested parties.



State of Wisconsin / DEPARTMENT OF NATURAL RESOURCES

P.O. Box 791  
Madison, Wisconsin 53707

Carol D. Besadny  
Secretary

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

IN REPLY REFER TO: 3550

January 28, 1991

Colonel William Badger  
U. S. Army Corps of Engineers  
St. Paul District  
1135 U. S. Post Office & Customhouse  
St. Paul, Minnesota 55101

Dear Colonel Badger:

Compliments are in order for the St. Paul District's efforts to follow through on the GREAT-I study by the initial meeting of the River Maintenance Coordination Forum and release of the Implementation Report (Iratt). I feel both items are vital to the success of the GREAT-I study as we prepare to implement the "action" acronym in GREAT. I also appreciate this opportunity to comment on the Implementation Report (Iratt) for GREAT-I. Both general and specific comments are attached for your consideration.

Sincerely,

*Carol D. Besadny*

C. D. Besadny  
Secretary

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Enc.

The St. Paul District looks forward to working with the Department of Natural Resources in the operation and maintenance of the 9-foot channel and implementation of many of the GREAT I recommendations.

#### GENERAL COMMENTS

The St. Paul District's recommendation to implement the Channel Maintenance Plan by the First Priority Program is acceptable.

Much criticism has been made of cost estimates produced by the GREAT-I Team for the Channel Maintenance Plan and other recommendations. The Corps was the agency that produced the Channel Maintenance cost figures. This report does not need to further refine costs (Appendix B) so that implementation decisions are justifiable. Yet this report also takes significant attention to cost assumptions, assigns cost figures for implementation of the First Priority Program (Table 15), for Table 16 cost benefit analysis for implementation of the Early Implementation Program (Table 17), and for the First Priority Program (Table 18) and projected costs (Appendix E). As the GREAT-I Team debated Channel Maintenance Plan cost calculations made in this report are speculative. It would not seem appropriate to keep this argument alive, what would seem logical is to go out and demonstrate equipment types so that cost projections can be verified or refuted. From such demonstration, which should comply with Channel Maintenance Plan conditions recommended, the proper mix of equipment should become known. The 1985 goal for Channel Maintenance Plan compliance would then be more attainable than by a continuation of cost feasibility disputes. It would seem necessary then that the dredging equipment demonstration project, as outlined on page A-12, should be upgraded to Basic Program status so that this information is more usable for implementing the First Priority Program for the Channel Maintenance Plan. The Team emphasized this demonstration should be conducted in 1980 or 1981, and this recommendation must be done in this time frame if 1985 Channel Maintenance Plan compliance is to be reached.

The qualifier "to the maximum extent possible" has been repeated many times in reference to the Channel Maintenance Plan implementation of the First Priority Program as well as the other alternative programs. Wisconsin certainly agrees that there will be site specific examples where a better alternative may be appropriate. However, we strongly feel that the Channel Maintenance Plan was the best plan available from all perspectives and we would strongly oppose its reconsideration. We feel it imperative that the St. Paul District initiate budgetary requests so that full compliance of the Channel Maintenance Plan by 1985 is attained. Appendix B represents where the St. Paul District has problems with implementing the Channel Maintenance Plan. Rather than pointing out the supposed shortcomings, the time spent for preparing this chapter would have been better spent outlining how these problems could be overcome. The Corps, as the experts in this field, should be the leaders in carrying out a plan that was, after all, agreed to by their agency. If these problems were brought forward at the appropriate time, during the GREAT-I study itself, they would have been addressed, if properly justified. The Channel Maintenance Plan is not cast in concrete.

#### ST. PAUL DISTRICT, CORPS OF ENGINEERS DISCUSSION/RESPONSE TO COMMENTS

1. Cost estimates are difficult to determine and will vary if different assumptions are used. They depend on the accuracy and detail of information available. Additional equipment analysis, including demonstration dredging, is needed to improve the reliability of the cost estimates. Many other variables, such as the efficient quality of placement operations (particularly for non-contaminated material), must also be considered. Demonstration projects have high priority.
2. We agree that the CMP is not cast in concrete but is a flexible plan that will serve as a starting point for further evaluations. See the discussion of the CMP beginning on page F-14.

ST. PAUL DISTRICT, MISSISSIPPI RIVER  
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We are willing to work with you so that problems can be resolved, but we do not and will not accept self-imposed or self-supposed limitations for implementing the Channel Maintenance Plan. We have initiated the legal action necessary to allow use of disposal sites that do not conform to Wisconsin state laws. We would not be amenable to broad legislation from this action or any action that would require reconsideration of the Channel Maintenance Plan. Going to our legislature for numerous exceptions to state laws not justified by the GREAT-1 study would not be possible. Any exemptions will be site specific, not a broad exemption to the laws of the State of Wisconsin.

Enhancement projects and studies for recreation and fish and wildlife as described in the First Priority Program are highly desirable. Federal cost-sharing policies, and St. Paul District's philosophy to use these policies seem flexible, sometimes depending on annual dredging requirements to determine the extent of implementation and non-federal cost-sharing requirements. We strongly support the St. Paul District's recommendation to separate funding so that these purposes (fish and wildlife and recreation) are not subjected to transfer for dredging purposes.

The concept of funding carryover during low dredging years is highly supportable and seems most appropriate when considering that budget requests are based on average annual dredging requirements.

Regarding policy change recommendations for the Chief of Engineers, the need to utilize non-federal land for dredged material disposal is certain. A large number of controversies surrounding the use of dredge disposal sites could be completely solved today with the simple leasing or buying of private land. Purchase of these sites, as opposed to long-term lease agreements, may not be necessary. Leases could reduce the expected cost necessary to use these privately-owned sites. Other policy items recommended are supportable.

Authority to implement actions for fish and wildlife and recreation should be made a part of the First Priority Program and such authority immediately sought from Congress. It is high time that Congress and its program agencies recognize the unique features of the Upper Mississippi River as a natural resource so that its environmental values and recreational opportunities are protected by appropriate authority and through the budgetary process.

Program options as outlined in Appendix A do not definitively lay out how the Corps intends to implement and participate in implementing the GREAT-1 recommendations. Several action item recommendations are discussed in further study or planning terms. This section also refers to priority items within each program. It should be a purpose of the River Maintenance Forum to determine recommendation priorities within the capabilities of each program. We assume that in this interim stage implementation of the Basic Program will be subject to the influence

of the Corps and the State of Wisconsin. The Corps' support on this is a major factor in the implementation of the Channel Maintenance Plan. The Corps' support on this is a major factor in the implementation of the Channel Maintenance Plan.

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ST. PAUL DISTRICT, CORPS OF ENGINEERS  
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<p>on this Form. As new capabilities are obtained through the appropriations and authority recommendation process (for implementing the First Priority Program and Early Implementation Program), the Forum will also be able to work out recommendations to the Corps for implementation priorities (similar to the GREAT process).</p> <p>Discussion of fish and wildlife considerations for implementing Action Item 1 (Phase D-De) should be represented in the cost benefit analysis presented in Table 7 (and narrative on page 32).</p> <p>Other comments on the District Engineer's report on GREAT-I implementation may be forthcoming.</p> <p>To conclude these general comments, we repeat that the St. Paul District's efforts to outline its intentions for implementing the GREAT recommendations are appreciated. The concepts presented in this report are, for the most part, agreed to, particularly in terms of the Channel Maintenance Plan as a First Priority Program. It is not in our state's interest to renash GREAT arguments, but instead to expeditiously promote implementation of recommendations. We feel that the St. Paul District could best accomplish this by providing detailed site plans of all GREAT-I Channel Maintenance Plan activities to initiate required permitting actions, and by immediately requesting information for FY'81 to our state so that we could offer our assistance in influencing appropriate Congressional decisionmakers.</p>	7	<p>8. Additional discussion has been added to Appendix E. The table referred to has been modified.</p>
<p>Other comments on the District Engineer's report on GREAT-I implementation may be forthcoming.</p> <p>To conclude these general comments, we repeat that the St. Paul District's efforts to outline its intentions for implementing the GREAT recommendations are appreciated. The concepts presented in this report are, for the most part, agreed to, particularly in terms of the Channel Maintenance Plan as a First Priority Program. It is not in our state's interest to renash GREAT arguments, but instead to expeditiously promote implementation of recommendations. We feel that the St. Paul District could best accomplish this by providing detailed site plans of all GREAT-I Channel Maintenance Plan activities to initiate required permitting actions, and by immediately requesting information for FY'81 to our state so that we could offer our assistance in influencing appropriate Congressional decisionmakers.</p>	9	<p>9. The St. Paul District is developing site plans at several of the highest priority sites and will coordinate the plans through the coordination forum.</p>
<p><u>SPECIFIC COMMENTS</u></p> <p><u>Introduction</u></p> <p>Page 4 - Certain findings of UMBC Level B, GREAT-II and GREAT-III will be relevant to GREAT-I, but due to unique characteristics of the Upper Mississippi River in the St. Paul District, many of these study findings may not be applicable.</p> <p><u>Problem Identification</u></p> <p>Page 12 - More than half (approximately 61%) of the St. Paul District is within the Upper Mississippi River Wild Life and Fish Refugia.</p> <p>- Some mention should be made of the fact that portions of the Upper Mississippi River and the GREAT-I Study Area are the only locations federally designated for the dual purpose of navigation and refuge.</p>	10	<p>10. Concur.</p>
<p>Page 16 - While the upland erosion backwater sedimentation problem is certainly a critical issue which needs to be addressed, it may not be the most pervasive and damaging problem in the Upper Mississippi River.</p>	11	<p>11. Additional text has been provided to reflect this comment.</p>
<p>Page 16 - While the upland erosion backwater sedimentation problem is certainly a critical issue which needs to be addressed, it may not be the most pervasive and damaging problem in the Upper Mississippi River.</p>	12	<p>12. This page has been revised to reflect your concern.</p>

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
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| <p>Also, tributary (including the Chippewa, Root, Rumbo Rivers and others) sediment yields may contribute bed load material which is eventually dredged to maintain the navigation channel. Shifting of bed material within the channel, secondary movement of spoil material, tow prop wash, and other influences contribute to dredging requirements.</p> <p>Page 21 - Constraints, how about Executive Orders 11988 and 11990?</p> <p>Page 23 - Can you document examples of how state water quality standards damage other resource values?</p> <p>Page 32 - Benefit-cost analysis narrative (and Table 7) should at least include representative benefits to recreation and fish and wildlife.</p> <p>Page 33 - Is privately-owned placement site acquisition always necessary or could lease agreements be obtained?</p> <ul style="list-style-type: none"> <li>- Chief of Engineers policy may need to be changed but legal capability already exists (UMBC Master Plan, Dredged Material Disposal Legal Study, 1980).</li> </ul> <p>Page 4 - Shoreline protection measures can reduce dredging requirements by containing flow within channel boundaries, reducing sediment production from main channel border areas, and other factors which are directly related to channel maintenance.</p> <p>Page A-4 (AI-1) - First Priority Program calls for advanced removal of material from emergency sites as feasible. GREAT-1 explicitly recommended removal before additional placement as in AI-8.</p> <p>Page A-5 (AI-3) - All programs should recognize benefits to fish and wildlife as a result of shoreline protection to improve cost/benefit analysis.</p> <p>Page A-6 (AI-5) - "Attempts" or "plans" to utilize mechanical dredging equipment are not good enough. Implementation of the Channel Maintenance Plan will require this capability and its use should be examined as soon as possible (PSI, page A-32 calls for demonstration projects in 1980 or 1981). AI-5 is, after all, an action item.</p> <p>Page A-7 (AI-7) - Present equipment limitations do not allow disposal site use which are accessible for beneficial use removal. What's needed here is the equipment capability needed to implement the Channel Maintenance Plan and an awareness program so that potential users (as identified by GREAT) are informed of material availability.</p> | <p>13</p> <p>14</p> <p>15</p> <p>16</p> <p>17</p> <p>18</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> |
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| <p>13. This information has been added.</p> <p>14. Although these executive orders are considerations, they have not required significant changes as the statutes referred to have.</p> <p>15. This section has been revised; however, increasing placement site size to provide ponding capacity increases physical impacts at the site.</p> <p>16. The table and narrative have been revised.</p> <p>17. Lease agreements are preferred. See the discussion of land acquisition beginning on page 1-4.</p> <p>18. While this statement is true, the savings seldom justify the costs of shore protection.</p> <p>19. Comment noted.</p> <p>20. Environmental effects of any bank protection will be evaluated.</p> <p>21. Implementation of the CMP will require additional equipment capability and funds. Additional evaluations, including equipment demonstration, will also be needed.</p> <p>22. Comment.</p> | <p>13</p> <p>14</p> <p>15</p> <p>16</p> <p>17</p> <p>18</p> <p>19</p> <p>20</p> <p>21</p> <p>22</p> |
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ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

- Page A-8 (AI-9) - None of the programs listed would comply with either the interim or long-term goals of this recommendation. 25
- Page A-10 (AI-10) - This recommendation should be accomplished immediately so that Channel Maintenance Plan implementation can begin. 26
- Page A-11 (AI-12) - As sediment control is highly applicable to channel maintenance, the Corps should be much more involved in this recommendation than saying it's a good idea. 27
- Page A-15 (AI-25) - This recommendation, calling for bikeway establishment with the Great River Road programs, sounds applicable to Corps Recreation Master Plan and as a potential beneficial use of dredged material. 28
- Page A-21 (P/F-1) - This is a problem. Present authorities do not recognize the needs of "other resource requirements" consistent with commercial navigation needs. Continued efforts to obtain funds in these authoritative constraints will not adequately meet the need of this multiple-use resource. 29
- Page A-22 (P/F-6) - Basic Program description is not consistent with the Channel Maintenance Plan or with the beneficial use concept. 30
- Page A-23 (P/F-7) - Wisconsin would not seek full-scale modification of Section 30.12. Specific projects for disposal sites can be given exemptions but only on a site-by-site basis and when adequately justified. 31
- Page A-25 (P/F-11) - None of the outlined strategies are acceptable, including the Full GREAT Program. As part of the Basic Program, the Corps (and the Fish and Wildlife Service) should request Congress to provide funding and authority to accomplish fish and wildlife projects. 32
- Page A-28 (P/F-19) - Action outlined should include coordination with the Fish and Wildlife Service (Refuge) and states. 33
- Page A-32 (PS-1) - First Priority Program should be immediately implemented in order to achieve Channel Maintenance Plan compliance by 1985. 34
- Page A-33 (PS-5) - Actions outlined in all programs are not acceptable. All structures should be assessed to determine present condition, applicability to dredging requirements, applicability to backwater sedimentation, etc. Results of specific analyses at Read's Landing and Lansing should then be incorporated so that appropriate maintenance measures are taken. 35

25. Detail identified the Environmental Protection Agency and the States as having primary responsibility for implementing this recommendation. The actions outlined in Corps programs describe the Corps' actions toward implementation of this recommendation.
26. While important, the sediment control program (Action Item 12) is directed at the fine sediments that affect backwaters relatively more significantly than channel maintenance dredging requirements.
27. The bikeway will not be addressed because the Great River Road is outside the Corps' property boundaries along the river. If dredged material could be used for bikeway construction, ways to satisfy this need would be explored.
28. Appropriations will be requested to implement the First Priority Program which does address "other resource requirements" within the Corps' role.
29. Unless additional funding is available, the full CMP cannot be implemented.
30. This approach could delay implementation of the CMP if modifications are necessary.
31. The request for additional authority could be handled through the Army Civil Works Legislative Program. Additional discussion is in the section beginning on page F-2.
32. This item has been added.
33. The First Priority Program will be implemented as quickly as possible within the funding constraints imposed on the District.
34. The programs have been revised.

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ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

7.

Maintenance Plan disposal. Condemnation should not have to be a widespread necessity. Also, the legal implications of providing dredged material to private interests has now been determined (OMRBC Master Plan, Dredged Material Disposal Work Team Legal Study, 1980).

Page B-5 - Wisconsin has initiated legal action needed to allow disposal at those sites included in the GREAT-1 Channel Maintenance Plan. Availability of detailed site plans from the Corps at the earliest possible time would assist this effort and would result in expeditious transition into Channel Maintenance Plan compliance.

Page B-6 - As uniform water quality standards for dredging would be of value to Corps operations, they should be interested in taking a lead role in the establishment of such standards. The recommendation (AI-9) addressing this is not outlined in Appendix A as a major Corps involvement for implementing.

Page B-7 - Capacity limitations at some sites may require beneficial use removal promotion by the Corps. Any physical restrictions that must be overcome will be evident when placement site plans are available.

Page B-7-8 - Exact costs for Channel Maintenance Plan compliance are not predictable until test cases (demonstrations) are conducted. Even then, each disposal operation will have conditional influences which are incalculable. It's ironic that Corps produced costs in the GREAT-1 Channel Maintenance Plan are questioned in this report and yet other cost calculations throughout this report are also predictions (and assumptions) which are disputable.

Page B-8-21 - Dredging Equipment. As the Corps chaired the equipment needs work group, it is surprising to find "new" information available which would have been useful for Channel Maintenance Plan formulation. The outside sources (sales representatives, construction operators, and manufacturers) used to generate this information should be identified.

Page B-19-21 - Pipeline placement can be very damaging to shallow aquatic and upland habitats.

Page B-22-23 - If there are problems with using these disposal sites, a better alternative should be recommended for consideration of plans developed to overcome these problems. The degree of reasonability used to make this list (III A, 1-16) is mainly questionable.

42. The State of Wisconsin is to be commended for initiating modifications to its laws to allow implementation of the CMP. Any modifications should recognize the flexibility required to implement the plan.

43. While the Corps is interested in the development of these standards, lead agency responsibility and authorities are with the Environmental Protection Agency and the State.

44. Concur.

45. Cost estimates for implementing the CMP will continue to change as additional data are obtained on specific details of the plan.

46. Technical representatives of the manufacturers listed in the table were contacted. The additional information in Appendix B is considered important in trying to develop an equipment package that will work in implementing the CMP. The GREAT-1 Material and Equipment Needs Work Group concentrated more on evaluation at individual sites. As needs are better identified, the level of detail on available equipment will also improve.

47. Concur. Pipeline has to be placed with care in any hydraulic dredging and placement.

48. Access problems at these and other sites will be addressed in greater detail when detailed site evaluations are made. These evaluations will be coordinated through the coordination forum.

Page B-36 - Further assessment of this information is required before the selected equipment conclusions can be agreed to.

Page C-14 - While high dredging years may present a problem, the use of temporary sites as recommended by GREAT-I was not recommended as an insurance policy to accommodate large volume operations. The conditions for temporary site use are restrictive and the intent of temporary site use is to prevent barge traffic delays, not as a normal operation disposal site alternative. Also, the 928,000 CY projection is not GREAT-I's, but a modified figure first presented in this report. Again, these projections are subject to many influences which are incalculable.

Page D-15 - Bathubs may have reduced adverse water quality impacts from dredging but have tremendously increased the potential for other adverse impacts. Further use of this placement technique should be abandoned.

Page D-16-17 - If the St. Paul District is so interested in accomplishing AI-9, then the level of its involvement as outlined in Appendix A should be greatly increased.

Page D-18-19 - The statement that "O & M activities have little or no impact upon the floodplain and flood flows," and the remaining floodplain impact discussion is not supportable and is in direct disagreement with the findings of the GREAT-I Flood Plain Management Work Group.

Page D-21 - There is no recommendation from GREAT-I which would reduce present equipment capability to maintain the navigation channel. Also, the Upper Mississippi River navigation project is authorized by Congress as a nine-foot project. All evidence to date shows that a deeper depth project would not be feasible.

Page E-23 - Dredging requirements have been reduced in recent years because of reduced depth dredging, but also because the need to dredge (and the river's ability to stabilize at a navigable depth) have also been a major factor.

Appendix E - Complete analysis of this section will be conducted after receipt and review of the remainder of this appendix.

# ST. PAUL DISTRICT, CORPS OF ENGINEERS

## DISCUSSION/RESPONSE TO COMMENTS

49. These conclusions are preliminary; additional analyses will be made.

50. Concur. But large volume operations will be necessary during peak dredging requirements.

51. Because the GREAT I designated temporary placement sites are "bathubs," it is unlikely that these sites will be completely abandoned in the foreseeable future.

52. Although the statements in Appendix D may disagree with the Department's interpretation of the findings of the GREAT I Floodplain Management Work Group, the St. Paul District believes the findings indicate potential increases in flood stages under certain conditions. Practical considerations and evaluations of actual conditions are needed to further clarify this concern. However, as stated in Appendix D, the District does not believe effects on flood stages would be significant.

53. This comment is a misinterpretation of what is stated on page D-21. That is, the capability of present equipment is not adequate to fully implement the AI-9.

54. Many theories have been advanced to account for reduced dredging requirements in recent years. The data needed to identify the real reasons and magnitude of reductions do not yet exist. As additional data are obtained, a better understanding of what affects dredging requirements will be reached. The discussion on page E-23 is only presented to show relationships to overall costs of dredging.



State of Wisconsin \ DEPARTMENT OF TRANSPORTATION



Colonel William W. Badger  
District Engineer  
St. Paul District Corps of Engineers  
1135 U.S. Post Office & Custom House  
St. Paul, Minnesota 55101

January 14, 1981

OFFICE OF THE SECRETARY  
Room 1208 Sun Farm State Office Bldg  
4805 Sheboygan Avenue  
P. O. Box 7910  
Madison, WI 53707  
Telephone 764-1113

Dear Colonel Badger:

As offered by your letters of December 8 and 19, 1980, I am taking this opportunity to comment on the draft of the St. Paul District "Implementation Report" for the GREAT I study.

I am pleased that the Report recognizes the importance of the continuation of the river system capability to handle the commercial traffic which is essential to the economic well being of this area and the country.

The Report presents a reasonable approach to insuring that the recommendations of GREAT I are recognized and implemented. While a more dramatic implementation proposal may be consistent with the desires of all interested parties, the approach documented in the "Implementation Report" attempts to respond to environmental and economic concerns as well as Federal, state, and local interests. The Report does recognize budgeting constraints and at the same time provides options to be pursued if more funds are made available.

As a participant in the GREAT I effort, I thank you for the opportunity to comment on this Report.

Sincerely,  
  
Lowell B. Jackson  
Secretary

LBJ:krg  
cc: Linda Bochart, Wisconsin DNR  
Jim Lissack, Wisconsin DNR, Eau Claire

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

The St. Paul District looks forward to working with the Wisconsin Department of Transportation on the continued operation and maintenance of the 9-foot channel and implementation of GREAT I recommendations.

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

UPPER MISSISSIPPI WATERWAY ASSOCIATION

St. Louis, Mo.  
June 1898  
St. Louis, Mo.

1. The first step is to identify the problem or question that needs to be answered. This involves understanding the context and the specific information required.

January 29, 1981

OFFICERS 1940-41

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Andrew Nelson

**PRESIDENT**

**Carol Brown**

**AND VICE PRES.**

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**ITEM A THREE**

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ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

cc: Mr. Raymond L. Kassell, Director, Iowa Department of Transportation  
Admiral Norman Venske, Commander, 2nd Coast Guard District, U. S. Coast  
Guard, U. S. Department of Transportation  
Mr. Norton L. Quave, President, Upper Mississippi Waterway Association  
Mr. Dan Galloway, Master Plan Project Manager, Upper Mississippi River  
Basin Commission

Page 2

Up to this point I do not think that I would receive serious objections to  
our stance from members of the Upper Mississippi Waterway Association or  
representatives of commercial navigation interests. However, tucked away  
in the Implementation Report for the GREAT I Study under "Policy Changes" on  
Page 41 we find the following:

"A policy change would be required by the Chief of Engineers in the  
area of acquisition of private lands for the placement of dredged material.  
While the authority exists to purchase private lands for placement of  
dredged material, the general policy has been to use available Federal lands  
or private or public lands with the consent of the owner. In many cases this  
has resulted in major conflicts on the location of a suitable placement site.  
The GREAT I Channel Maintenance Plan has numerous placement sites agreed upon  
by the GREAT I Team that are in private ownership and must be acquired to  
make the plan workable."

The ramifications of the proposed policy change are shattering. While on the  
one hand, the Corps might be expected to pay for lands acquired from private  
ownership for the placement of dredged material, in the converse, they might  
also acquire sites now in private ownership which the owners have no desire or  
intent to sell, preferring to keep such riverside property for development  
in accordance with their long term development plans.

Generally, puts acquisition of private lands within the grasp of environmental-  
lists.

This proposed policy change, in my opinion, may have the implications of  
transcending even the substantial concerns that we have over reduced depth  
dredging and restrictions on the hydraulic dredging capability of the Corps in  
the GREAT I Channel Maintenance Plan.

I wonder if Cargo Carriers, Inc. would not want to raise serious objections to  
this policy change in consideration of the negotiations with the Lower Minnesota  
Watershed District relative to the six dredged material disposal sites on the  
south side of the Minnesota River which have been identified by them, one of  
which is owned by Carnall, and which, I understand, you have no desire to sell.

I would be pleased to have an opportunity to discuss this with you.

Sincerely,

Rev. Jim  
Executive Vice President  
EAT/

cc: Col. William Badier, District Engineer, St. Paul District, U. S. Army Corps  
of Engineers  
Mr. Gerald W. Brown, Sales Manager, Cargo Carriers, Inc.  
Mr. John W. Lambert, Chairman, C.E.D., Twin City Basin, Inc.  
Mr. H. William Newstrand, Manager, Ports, Waterways and Freight Research  
Minnesota Department of Transportation

2. Refer to the discussion of acquisition of private lands beginning on page F-9.

# UPPER MISSISSIPPI WATERWAY ASSOCIATION

INCORPORATED IN MO  
P.O. Box 11116  
St. Paul, Minnesota 55107  
612-264-2863

Dedicated to navigation and sound water resource management

February 25, 1981

Col. William Badger  
District Engineer  
St. Paul District  
U. S. Army Corps of Engineers  
1135 U. S. Custom House and Post Office  
St. Paul, Minnesota 55101

Dear Col. Badger:

This will have reference to our several telephone conversations relative to my serious concerns relating to that portion of the Draft Implementation Report for Great 1 Study - November, 1980, in which the St. Paul District of the U. S. Army Corps of Engineers recommends implementation of the First Priority Program at increased annual operation and maintenance costs of approximately \$3 million dollars.

In our last telephone conversation on Monday, February 16th, I related to you my discussion of those concerns with Gen. Smith, North Central Division Engineer, Chicago, Illinois, and Joe D. Auburg, DAEN-CUP-W., Washington, D.C., in St. Louis, Missouri, on February 10th. Further, that I had subsequently learned from a usually reliable source that the North Central Division might be returning the draft to the St. Paul District with suggestions for revisions. Subsequently, on February 18th I was told that Gen. Smith has granted an extension for comments on the Draft Implementation Report for Great 1 Study until July 31st. From a Washington source attributable to Alex Schwariko, Chief, Office of Policy, U. S. Army Corps of Engineers, I learned that the Chief's office might not be too supportive of efforts to implement the GREAT 1 Channel Maintenance Plan at this time, especially in the light of the Reagan administration's budget-cutting efforts and the lack of cost-justification for the \$3 million dollar increase in the St. Paul District's operation and maintenance budget within the GREAT 1 Channel Maintenance Plan.

It is particularly disturbing to me that the U. S. Army Corps of Engineers would be giving credence, support, and even leadership to the implementation of proposals on which commercial navigation interests have expressed so much concern, specifically, the GREAT 1 Channel Maintenance Plan, which we feel has not been cost justified, but also raises serious impediments insofar as marine safety and serious concerns over the Corps capability to carrying out its Congressionally mandated responsibility for maintaining the 9 ft. channel project account reductions in over-depth dredging and reduced hydraulic dredging capability. Not only have we raised those concerns, but I have received letters from Adm. Norman Yenike, Commandant, 2nd Coast Guard District,

The Mississippi River Lock and Dam Navigation System: a priceless multipurpose national energy saving environmentally oriented transportation mode linking domestic and world trade areas by water with the Upper Midwest providing stable river water levels for stage by municipal private commercial recreational wildlife and aquatic interests

Overview 1980-81

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ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

1. The St. Paul District has been an active participant in GREAT 1 studies and has provided objective input and conducted professional analyses of the problems addressed during GREAT 1. The objective of the GREAT process was to develop a river system management plan that recognizes all resource requirements (fish and wildlife, navigation, recreation, etc.). Planning was conducted in the public arena, and all interested parties were welcome to participate. Views of commercial navigation interests were welcome and are still welcome. The concerns of commercial navigation are considered fully in the operation and maintenance of the 9-foot channel, but the concerns of other interests must also be considered. Congress authorized the Corps to build, operate, and maintain the channel, but it also passed other laws with which the project must comply. The principal justification for GREAT 1 recommendations is usually to comply with environmental laws or obtain unquantifiable fish and wildlife and recreation benefits. Letters from the Coast Guard and Iowa and Minnesota Departments of Transportation are printed in this appendix and the common concerns stated have been addressed with specific responses.

2 May 1964

Dear Mr. [Name]  
[Faint, mostly illegible text in the top right section of the page, possibly a letterhead or address block.]

[Faint, mostly illegible text in the bottom left section of the page, likely the first paragraph of a letter.]

[Faint, mostly illegible text in the bottom middle section of the page, likely the second paragraph of a letter.]

[Faint, mostly illegible text in the bottom right section of the page, likely the closing of a letter.]

Unfortunately, if organizations like the Upper Mississippi Waterway Association are to have no voice in the considerations or in the decision-making process at the local level, we are left but one alternative to pursue. The St. Paul District of the U. S. Army Corps of Engineers will be hard pressed to implement its First Priority Program if Congress does not appropriate the funds to do so and that may be the posture that we will be forced to take. However, it is probably advisable that we "roll back" the funding to the traditional cost of dredging and the personnel and payroll sans environmental section on the assumption that the St. Paul District has already incorporated many of the GREAT I recommendations and that the current operations and maintenance costs already are inflated by reason of extreme environmental sensitivity.

When you attended a recent Executive Committee meeting of the Upper Mississippi Waterway Association and again at the January 25th meeting with Governor Lee Dreyfus, State of Wisconsin, relative to the U. S. Highway No. 18 bridge at Prairie du Chien, Wisconsin, you gave assurances that the U. S. Army Corps of Engineers would maintain an adequate channel for the 9 ft. channel project from Guttenburg, Iowa to the head of navigation on the Mississippi River and that you could not conceive of the Congress permitting a channel closure. You referred to the "quick response" capability of the U. S. Army Corps of Engineers on the Mt. St. Helens catastrophic occurrence. I, frankly, do not see them as analogous. Commercial navigation interests are not concerned at all that the Congress would permit a channel closure, or, even any serious restrictions on the navigational capacity of the Upper Mississippi River. However, we are concerned with potential delays of four or five days that not only will occur, but have occurred, as a result of the lack of a working relationship existing between the states and the U. S. Army Corps of Engineers that will permit a "quick response" to such emergency situations and for which the cost can be measured in millions of dollars. In short, such situations should not be treated as "an act of God", but an inevitable occurrence by reason of failure to plan for their prevention.

You could probably argue that the Channel Maintenance Forum that the St. Paul District, U. S. Army Corps of Engineers has proposed and the GREAT I recommendation calling for the creation of a River Resources Management Agency are intended to establish that kind of working relationship. Having attended the February 5th meeting of the Channel Maintenance Forum I am not ready to let the future of channel maintenance rest in the hands of the Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, Minnesota Department of Transportation, Iowa Conservation Commission, Wisconsin Department of Natural Resources, Minnesota-Wisconsin Boundary Area Commission, U. S. Fish & Wildlife Service, U. S. Soil Conservation Commission, U. S. Coast Guard/U. S. Department of Transportation and the environmental section of the U. S. Army Corps of Engineers. I took it upon myself to find out whether the "state representatives" were really representatives of the Governors of those States or whether they merely attended because their agency was invited because of its participation in the GREAT I Study. You already know the answer. Despite efforts by the Corps of Engineers representatives, including yourself, to lay the basis that the Channel Maintenance Forum would have no authority, discussion included implementation of Chapter 8 of the GREAT I Report

# ST. PAUL DISTRICT, CORPS OF ENGINEERS DISCUSSION/RESPONSE TO COMMENTS

4. Additional funds are needed to implement most of the GREAT I recommendations. If funding levels are reduced, one consequence may be non-compliance with other Federal legislation applicable to channel maintenance activities.

5. Working relationships between State regulatory agencies and the Corps are most strained when funds are not adequate to accomplish assigned tasks with due consideration for other resources. When funds are severely limited, open communication between agencies and interests is even more important to continued operation and maintenance of the channel. The GNE and definitions of emergency dredging are efforts to improve the reliability of the channel recognizing the diverse interests along the river.



(which is not yet approved) and a "modus operandi" for preparation of the memorandum of agreements by the States. I fail to see how you could delegate your authority and responsibility for decision-making under the Congressional mandate which charges the U. S. Army Corps of Engineers with maintaining the 9 foot channel project, and with which I believe you agree based on a subsequent telephone discussion. My concern is that the Corps of Engineers has unwittingly "played into the hands" of the environmental advocates by creating a vehicle which it will be unable to constrain in efforts to usurp the authority delegated to the Corps by the Congress.

Probably commercial navigation interests have been extremely remiss in not making their concerns known more vociferously. Businessmen are reluctant to engage in the arena of public clamor and emotionalism. Logic to them dictates that the Congress has mandated that the U. S. Army Corps of Engineers will maintain the 9 ft. channel project through an adequate and cost-effective channel maintenance program. The historic posture of the U. S. Army Corps of Engineers has been it can and should be entrusted with that responsibility. Recently some of us have become increasingly more concerned as to whether that trust is still well-founded.

The role of a decision-maker or "chief head knocker" is indeed a difficult one, and certainly not a popularity contest, and I am sympathetic with your position. There is every evidence that you have been willing to listen to viewpoints from everyone. Possibly, the input of the GREAT I effort itself has been prejudiced. Commercial navigation interests participated in the GREAT I effort through the Commercial Transportation Work Team, however, it was out-voted at every stage of involvement of the GREAT I Study because the consist was overwhelmingly drawn from recreation and environmental interests or governmental agencies, including the Corps, who were advocates of those interests. Most representatives of commercial navigation would agree that the industry believed that "nothing good" would ever come from the GREAT I effort, and that our participation, at best, was defensive. One representative of a large towing company resigned from the Public Participation & Information Work Team because of an alleged "stacked deck". The efforts of the Commercial Transportation Work Team appear as an appendix to the GREAT I Report which no one ever reads. Few, if any, of the recommendations of commercial navigation escaped the "hatchet job" of the Plan Formulation Work Team on which representatives of the St. Paul District of the U. S. Army Corps of Engineers (environmental section) presided. Commercial navigation interests believe the GREAT I effort is a highly biased and slanted study and the recommendations are aimed at giving recreational and environmental interests everything they want by increasing the costs of channel maintenance by the U. S. Army Corps of Engineers based on recovery of the Corps operation and maintenance budget through waterway user charges.

I am sure that you are aware of the fact that on February 20th, Army, DOT and Treasury were asked to meet with DMB to develop Waterway User Charge legislation that would eliminate inland waterway subsidies, and which included implementation of the Reagan administration's 30 cent, per gallon fuel tax.

# ST. PAUL DISTRICT, CORPS OF ENGINEERS DISCUSSION/RESPONSE TO COMMENTS

6. The Corps does not intend to delegate authority or responsibility for operation and maintenance of the channel. However, it plans to seek out the views and concerns of those associated with the project to minimize the potential for adverse impacts.

7. The Plan Formulation Work Group consisted of the chairman of nine functional work groups, representatives of the Public Participation and Information Work Group, a coordinator, and the co-chairmen of GREAT I. St. Paul District participants represented their work group disciplines and the mandates of the GREAT I study with an aim toward reducing the potential for adverse impacts on any interest.

8. The GREAT I report does not make any specific recommendations on waterway user charges. However, Policy/Funding Items 12 and 13 address separation of costs and cost allocations to ensure appropriate designation of costs to the purposes which benefit from the expenditure. Appendix F of this report also presents a possible cost allocation procedure and outcomes in the Appendix A & C.

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

Based on Waterborne Commerce statistics, the loaded 1978 ton miles on the Mississippi River from Minneapolis to Baton Rouge were 105 billion. That level of commodity movement would use 204,280,150 gallons of fuel based on the Eastman Study. If we assume that 30 percent of the total movements were empty, then an additional 87,219,850 gallons of fuel were used, bringing the total usage to 291,500,000 gallons. At 30 cents per gallon fuel tax this will generate \$87,450,000 in taxes. The five year operations and maintenance costs of the U. S. Army Corps of Engineers (based on annual reports - nearly all expenditures are for main stem) for the Mississippi River from Minneapolis to the Gulf is \$64,107,000. OMB says the total expenditures for operation and maintenance on the inland waterway system is \$325 million. Cost allocation assigns 80 percent of operations and maintenance to commercial navigation, and 80 percent of \$64,107,000 is \$51,285,600 as commercial navigations "share" of the operations and maintenance cost for the Mississippi River. In short, the 30 cents per gallon fuel tax would produce 136 percent of total recovery of the Corps operations and maintenance costs or 170 percent of that portion of the Corps operations and maintenance budget allocated (80 percent) to commercial navigation.

This "surplus" over allocated costs is nearly \$36 million dollars and we see no need for the U. S. Army Corps of Engineers to "quickly adopt programs" to increase its operations and maintenance budget to "get rid of it" before it is even enacted.

I am hopeful that I may have demonstrated to you that the St. Paul District's implementation of the GREAT 1 Channel Maintenance Plan has elevated the GREAT 1 Study into the mainstream of the "battle of the budget" and "total cost recovery" so much in evidence at the Washington level.

While commercial navigation may be viewed as having selfish motivations with respect to this matter, I believe that the industry stands ready to assume its share of costs identified as being its responsibility through accurate cost allocation, and providing that all forms of transportation are treated equally and equitably and all beneficiaries of the Corps operation and maintenance costs are identified and bear their fair share of Congressional efforts to recover costs. By the time these concerns have been addressed by the Reagan administration and the Congress through legislation and the FY 82 and FY 83 budget process we will have a considerably better understanding of whether barge rates will be required to subsidize environmental concerns.

Meanwhile I recommend a period of "watching and waiting".

Sincerely,

Erv A. Timm  
Executive Vice President  
EAT/e

9. The Corps' approach to implementation of GREAT 1 recommendations is not related to waterway user charges. The recommendations that are justified and/or necessary to operate the project in compliance with existing laws are recommended for funding and implementation.

10. The St. Paul District looks forward to a continued good working relationship with the Upper Mississippi Waterway Association and other commercial navigation interests in the operation and maintenance of the 9-foot channel and implementation of many of the GREAT recommendations. The association's participation and interest in the coordination forum will help ensure that all views are considered.

**CARGO  
CARRIERS  
INCORPORATED**

15407 McGraw Road  
Minnetonka, Minnesota  
Mail Address: Box 5900  
Minneapolis, Minnesota 55440

February 18, 1981

Col. William Badger, District Engineer  
Army Corps of Engineers  
U.S. Army, Department of Defense  
180 E. Kellogg Blvd.  
St. Paul, Mn. 55101

Dear Colonel Badger,

Seven months ago, I wrote Mr. Fred Richards, of Popham, Haik, Schnobrich, Kaufman & Doty, Ltd., attorneys for the Lower Minnesota River Watershed District, setting forth the terms for a long term lease of ten acres of Cargill's Port Cargill, Savage, Minnesota property for use as a permanent dredge disposal site. I explained in my letter that the terms specified were for negotiating purposes and were not cast in stone. We also indicated Cargill has every intention of cooperating with the various Governmental bodies. Cargill does not wish to sell the property.

We have been led to believe that the Implementation Report for the Great I Study suggests a policy change which would allow the Corps to acquire sites in private ownership, which the owners have no desire to sell. If, in effect, the proposed policy change is a part of the implementation report, I wish to voice serious objections to it on behalf of my company. We strongly support the required dredging needed to maintain the nine foot navigational channel and are willing to make ten acres of our property available for dredge spoil. The confiscation alternative is not a satisfactory approach to land acquisition. I would be happy to discuss this matter further with you at your convenience.

Sincerely,

CARGO CARRIERS, INC.

Clinton B. Odell  
Vice President

cc: G. Hicks  
Erv Tinn - Upper Mississippi Waterways Assn.

ST. PAUL DISTRICT, CORPS OF ENGINEERS  
DISCUSSION/RESPONSE TO COMMENTS

Refer to the discussion of acquisition of private property beginning on page 1-9. Mr. Odell was contacted to give him the background on land acquisition policy changes and inform him that lands along the Minnesota River were not involved in this issue. The St. Paul District looks forward to a continued good working relationship with Cargo Carriers, Incorporated.

N  
8